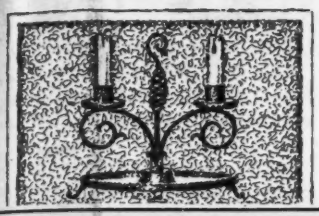
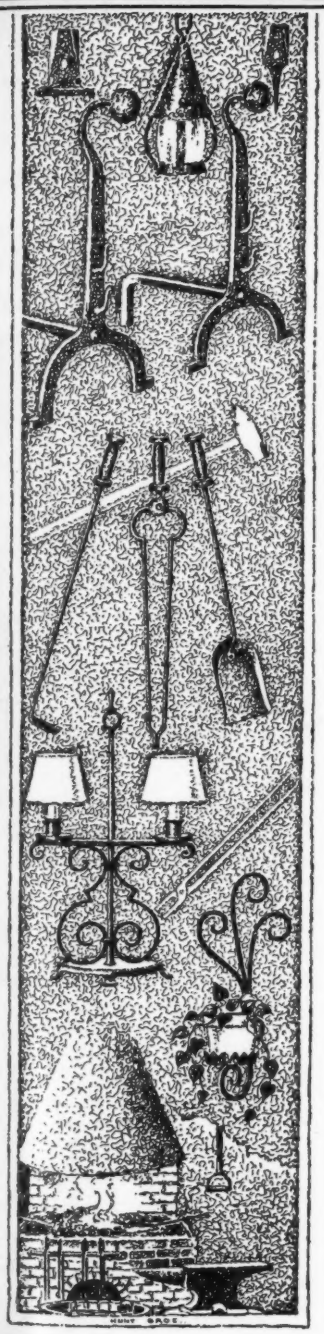


OCTOBER 1934

INDUSTRIAL ARTS AND VOCATIONAL EDUCATION



Wÿ moeten in het ſlaan volherden,
Zal 't kooper tot een keetel werden.
Men buigt niet licht een harde kwaſt,
't en zÿ men op den hamer paſt.

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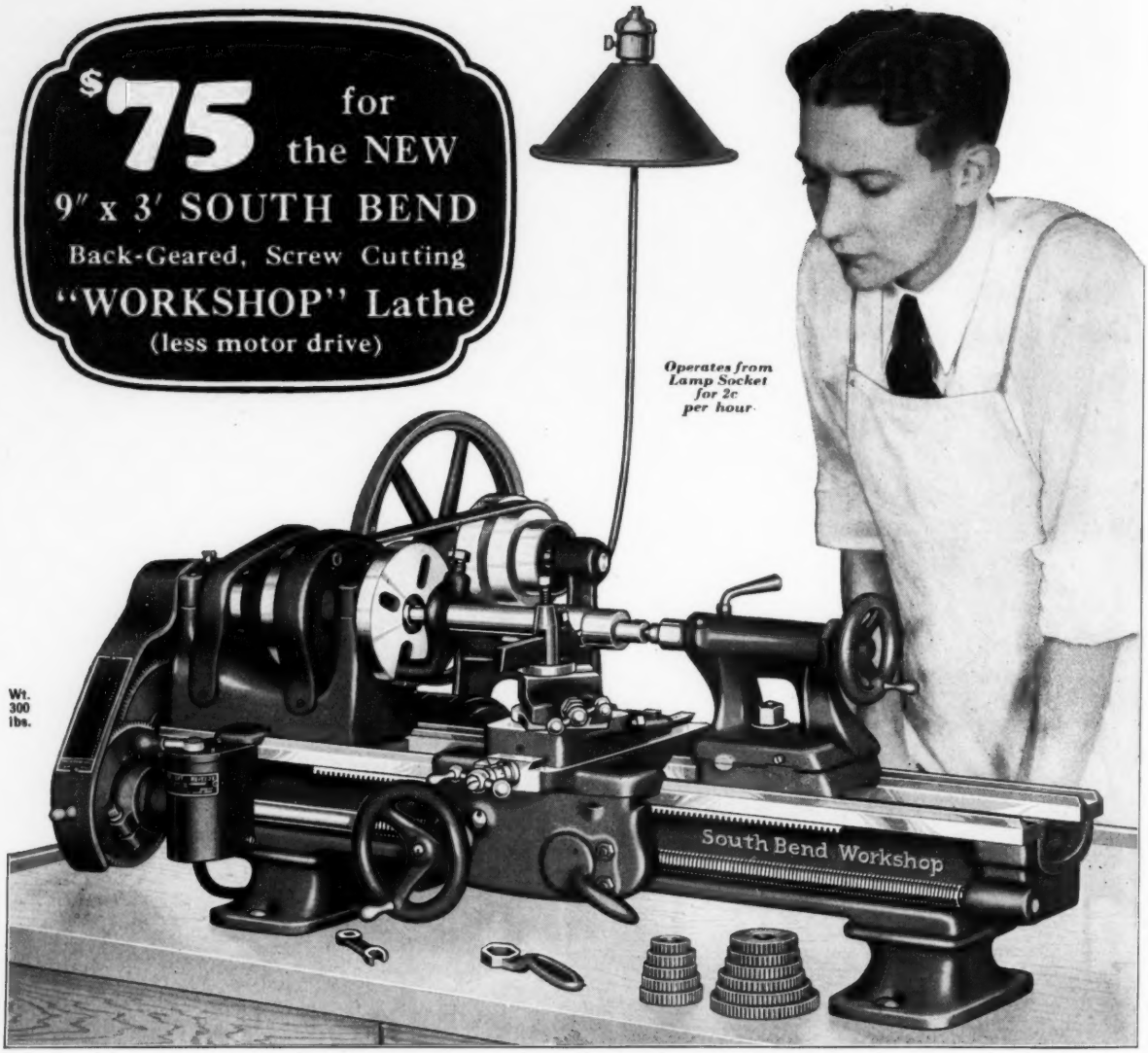

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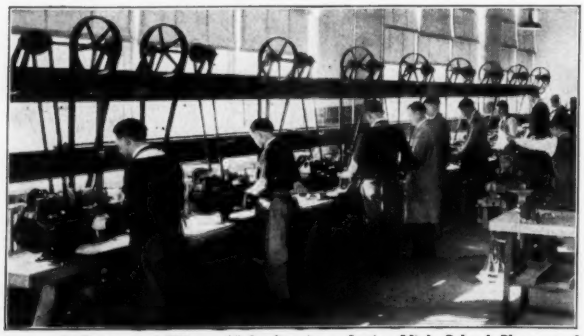

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INDUSTRIAL ARTS and VOCATIONAL EDUCATION
October, 1934
Vol. 23, No. 10

Student Achievement Factors

Leo R. Klinge

Assistant Principal in Charge of Clarke Branch, Crane Technical High School, Chicago, Illinois

The question "What makes for success?" has troubled man throughout the ages. The study presented herewith shows how the author proceeded to determine the answer to this question for students in patternmaking.

WHY do boys succeed or fail in shopwork, more specifically, in patternmaking? Does success depend upon intelligence, aptitude, skill, interest, vocational choice, or what?

The desire to be able to answer questions such as these with some degree of objective support, led the writer to undertake a study involving the possible influence of a number of factors, the more important of which will be discussed in this article.

The data for the study were secured in four classes, embracing a total of 102 students, in second-year patternmaking at the Crane Technical High School.

The School and Course

The Crane Technical High School is a school for boys located on the west side in Chicago, Illinois. In the homes of the boys are found wide ranges of nationality, economic status, and culture. In individual differences in size, age, intelligence, special aptitudes, and previous preparation, probably no more heterogeneous group is ever assembled in any high school.

No attempt is made to teach trades, yet some students, doubtless, acquire some vocational training. Shop and mechanical-drawing courses are organized on the theory that no young man's education for life in this day and age is complete without some understanding of modern industrial processes. A major objective of the patternmaking course is an appreciation of the contribution made by the cast-metal industry — consequently patternmaking — to present-day civilization.

Patternmaking is a combination of joinery, wood carving, and wood turning, and makes use of the tools of each, but the principles involved cannot be understood without a knowledge of molding, casting, and machining. The casting idea from which the pattern derives its dimensions must be understood and carried through what seems to the adolescent mind, a complex multiplicity of processes. It culminates in a piece of neatly and accurately made woodwork frequently not even resembling the original idea. Some of this work requires an ability to do abstract thinking far beyond the capacity of a second-year boy.

Procedure

The securing of data for the study continued throughout the twenty-week semester beginning in September, 1929, and ending in January, 1930. Among the factors considered are nationality of parents, chronological age, father's occupation, boy's occupational choice, choice of school shop, preferred study, success in other subjects, absence from school, and types of errors made. The Otis Group Test of Mental Ability, Higher Examination, Form A, was used as a basis for estimating the intelligence quotients. Stenquist Mechanical Aptitude Test 1 and the Sims Score Card for Socio-Economic Status, Form C, were given for the rating of these two factors.

Because of the variety of levels on which patternmaking is taught and of the varying degrees of preparation encountered, there is as yet little agreement as to scope or content in this field, and no standardized tests are available. Consequently, the writer devised two informal tests of high reliability which were administered in the eighteenth and nineteenth weeks. Both tests are rather comprehensive and cover a wide range of understanding of patternmaking principles and theory. One is of the true-false and one of the sentence-completion type. Both are conveniently arranged for objective scoring.

For the purpose of objective scoring of results in actual pattern construction an achievement-point scale was devised and each boy's work was scored independently by two teachers who taught similar work in adjoining rooms. The range of scores is from 0 to 30 points. A comparison of the two sets of scores results in $r = .9379 \pm .0081$.

Success, then, is interpreted to mean an actual accomplishment along the lines indicated, the decisive factor being whether the school grants credit for work pursued. The degree of success is indicated by the grades A, B, C, and D, the D being at the bottom of the scale, the failing grade, and carrying no credit. For statistical purposes, the numerical values 4, 3, 2, and 1 were assigned A, B, C, and D, respectively. This procedure is justified by the fact that the results obtained by four different methods show nearly perfect correlation.

Of the 102 boys receiving grades in patternmaking, 12 received the highest grade, A, 27 received B, 51 C, and 12 D.

Analysis of Results

Among the parents of the boys are represented 30 nationality groups. Of these, boys of American parentage received the most high grades, those of Russian next, and Italian third. The balance is too scattering to be worthy of mention.

There seems to be no outstanding correspondence between boys' success in patternmaking and the occupations of their fathers. In the case of boys' own occupational choices, the correspondence is more definite. Only five of the 39 A's and B's were received by boys whose choices were not in engineering or technical fields. It should be said, however, that a large majority of occupational choices were in technical fields.

There is no indication of correspondence between Socio-

Economic Status (Sims) and teacher's grades in patternmaking. The coefficient of correlation, .0219 ± .0667, is so low as to be of no significance.

No outstanding correspondence is indicated between grades and chronological ages, though, in common with other school grades, the higher ones tend slightly toward the lower age groups.

Interest appears to be a powerful factor. Of 41 boys who preferred shop to any other subject, 40 passed, 25 of them with high grades. Again, of the 32 who had elected patternmaking, 29 passed, 23 of them with high grades. The three who failed were absent from 15 to 27 per cent of the time and failed in nearly all other subjects as well.

Comparing grades in patternmaking with the composite grade of other subjects, we find 10 of the 12 boys with A in patternmaking achieved the median composite grade or better. The coefficient of correlation of all is .5377 ± .0475. This would have been higher if the number of A's in patternmaking did not greatly outnumber those in the composite score.

Since all of the boys with A in patternmaking and two-thirds of those with B were absent the median number of days or less, and since 10 of the 12 with D were absent considerably more than the median number of days, it would appear that attendance has a very definite influence upon success in patternmaking.

A comparison of grades in patternmaking with Stenquist Mechanical Aptitude Test scores shows all of those with A in patternmaking achieved the median Stenquist score or better, but the balance is so badly scattered that column comparison shows $r = .2519 \pm .0623$, too low to be of any significance. This is probably due, at least in part, to the fact that the Stenquist test used is a pencil-and-paper test and, like group mental tests, is based largely on mental functions such as recognition, imagination, and comparison. Such problems as arise do not appear to be comparable to those arising in the pattern shop.

GRADES IN PATTERNMAKING DISTRIBUTED ACCORDING TO INTELLIGENCE QUOTIENTS (OTIS)

Intelligence Quotients	Patternmaking Grades				
	A	B	C	D	Totals
126 - 130	1				1
121 - 125		1			1
116 - 120	1		3		4
111 - 115	1	3	5	1	10
106 - 110	4	5	5	1	15
Median 101 - 105	1	8	12	2	23
96 - 100	3	6	7	2	18
91 - 95		3	5	2	10
86 - 90	1		6	4	11
81 - 85			5		5
76 - 80		1	3		4
Totals	12	27	51	12	102
$r = .2692 \pm .0619$					

Table I

Using the Otis Group Test of Mental Ability, Higher Examination, Form A, we find a mean I.Q. of 100.32 with an S.D. of 10.11. The median lies in the interval 101–105. Referring to Table I we find that:

1 of the 12 A's is at the median, 7 are above, and 4 below.
8 of the 27 B's are at the median, 9 are above, and 10 below.
12 of the 51 C's are at the median, 13 are above, and 13 below.
2 of the 12 D's are at the median, 2 are above, and 8 below.

This type of comparison of data by grouping with relationship to the median indicates some correspondence though column comparison of scores of individuals shows a correlation of only .2692 ± .0619, too low to be significant.

This coefficient, .2692, is strikingly similar to the .2519 given in the previous paragraph, one might say for the reasons given in that paragraph. Yet, curiously enough, in comparing the Stenquist scores and the I.Q.'s with each other, r equals only .0568 ± .0665. That is:

Comparing patternmaking grades with Stenquist scores ..... $r = .2692$
Comparing patternmaking grades with I.Q.'s..... $r = .0568$
Comparing Stenquist scores with I.Q.'s..... $r = .2519$

Interpretations, Conclusions, Comparisons

From the standpoint of evidence from data assembled in this study which are considered as having a statistically significant bearing on the major problem, it would seem that success in patternmaking is a haphazard chance, a conclusion which the writer is decidedly reluctant to accept. After years of observation in his own patternmaking classes and in those over which he has had supervision, the writer is certain that the bright, alert fellow responds more readily to instruction, is more capable of understanding how and why a certain thing is to be done and is usually able actually to do it better than the duller one. He may be distinguished from the dull one by his ability to make and follow a plan, to adjust his procedure to the needs of his plan, and to correctly evaluate his work. It is evident that the qualities which make for success in patternmaking are not measured by tests consisting of exercises requiring the mental reactions involved in "recognition of opposites," "missing steps in series of numbers," "proverbs," "analogies," and "selected best reasons."

In order to test the accuracy of a notion fairly prevalent among some teachers and parents, that success or failure in shopwork depends entirely upon ability to use the hands, the writer has on three occasions attempted an analysis of the types of errors made by boys in the school pattern shop.

These data have been judged insufficient for statistical analysis. However, on the basis of a classification made in consultation with a psychologist, approximately 85 per cent of them on each of the three occasions have resolved themselves into what might be classed as "headwork errors" as distinguished from "handwork errors." They have been due largely to:

Lack of attention.
Lack of foresight.
Lack of concentration.
Lack of recall.
Lack of resourcefulness in ideas.
No clear concept of aim.
Loose, inaccurate thinking.
Failure to follow directions.
Failure to recognize the problem.
Failure to keep it clearly in mind.
No capacity for self-criticism.
Impulse to have work O.K.'d even though not ready.
"Bluffing" habit of "getting by" on poor work.

In the light of this factual material it is disturbing to one's faith in the validity of various standardized tests to find a coefficient of correlation of .2692 between patternmaking grades and I.Q.'s, and of .2591 between patternmaking grades and Stenquist scores. Nor is there any compensating satisfaction in the discovery of a coefficient of only .0568 between I.Q.'s and Stenquist scores.

This lack of faith in the adequacy of present-day standardized tests and examinations does not lack support in the opinions and findings of reputable psychologists and other scientific workers and of test makers themselves. Space does not permit of numerous or lengthy discussions but a few short quotations may be of interest.

Stenquist[1] believes that " . . . in the academic atmosphere of our classrooms we have come to value the attributes which intelligence tests measure out of all proportion to their value in life."

[1]Stenquist, John L., *Measurement of Mechanical Ability*. Teachers College Contributions to Education, No. 130 (New York: Teachers College, Columbia University, 1923), 101 pp.

Toops[2] found very little correlation in the results of mechanical-aptitude tests and intelligence tests. He says: "This rather low intercorrelation may indicate a greater confusion in the minds of the builders of mechanical tests in regard to what they are attempting to measure than in the case of the builders of intelligence tests."

Board, Marsh, and Stockwell[3] conclude, after one of their studies " . . . that success or failure in mechanical work cannot be predicted with tests as a sole basis for judgment." Also "There is great question . . . as to whether mechanical-aptitude tests measure mechanical abilities or experiences only."

Beauchamp and Webb[4] claim that "resourcefulness is one of the qualities upon which success is founded and that present-day widely accepted tests do not measure that quality at all."

McCall[5] says, " . . . the psychological tests recommended measure, primarily, abstract ability . . . the ability to handle ideas and symbols rather then to deal with things and their mechanisms."

Witty and Lehman[6] conclude as a result of their studies, "In the light of the discussion given in the foregoing, it is clear that the mental testers must abandon the assumption that mental tests measure general intelligence."

Turney[7] regards information on industry, perseverance, ambition, dependability, etc., of more importance than intelligence-test scores.

Thorndike[8] says, "What little we know seems to indicate that such tests, composed primarily of verbal and mathematical content, are somewhat closely indicative of ability to learn from lectures and books and to deal with ideas and symbols, but are much less closely indicative of ability to understand and manage things and people as they exist in concrete reality." Again, "The chief misuse of which we are likely to be guilty is to assume that the test score is a measure of general intelligence and that general intelligence constitutes 80 or 90 per cent of all intellectual ability. On the contrary, the test score is a measure of the individual's status in rather specialized acts of intelligence."

Many a guidance officer is entirely innocent of the degree to which certain vocations deal with purely repetitive operations or with activities that require a measure of concentrated attention, foresight, judgment, resourcefulness, and perseverance. Yet these officers in thousands of cases are offering advice which guides boys into various shop courses, of which the advisers know little, simply because of low scores in tests which measure only "very specialized acts of intelligence."

Dean Haggerty long ago reached the conviction that examinations at present are hopelessly inadequate. He questions whether they do what we propose they should and says we should be slow about basing anything upon them so long as they are so poorly constructed.

Summary

The data in this study are too limited to permit the formation of sweeping conclusions. Some conclusions, however, seem warranted. While the coefficients of correlation are all positive, only one relating to success in patternmaking is even "marked": that between shop marks and other school marks. This one, .54, compares favorably with those developed in other studies. All the coefficients dealing with standardized tests are so low as to be less than five times the probable error and have no significance.

From the standpoint, then, of evidence from the data assembled in this study which have a statistically significant bearing on the major problem, only two conclusions are warranted:

1. A boy who has high marks in other school subjects will probably have reasonably high marks in patternmaking; and

2. Regularity in attendance has a very definite favorable influence upon success in patternmaking.

From a statistical standpoint, then, the outcomes of this study have been negative, as little evidence of statistical significance has been developed. All the factors which the writer believed might affect success or failure in patternmaking were brought together. If the standardized tests really test what they purport to test, and if this type of data lends itself to refined statistical treatment, then success in patternmaking is clearly a haphazard chance and has no relation to intelligence or even to mechanical aptitude, a conclusion which anyone with only a smattering of shop sense is bound to reject.

Examination of factors perhaps not statistically significant affords something in the way of conclusions. An excess of absence is invariably associated with attitudes of indifference and irresponsibility. This, coupled with the effects of the Illinois high age attendance law, the frequency with which the home environment is antieducational, and the large number of cases in which a study is taken as a forced assignment, make for an attitude of indifference and lack of interest and industry almost impossible to overcome. This is rather strikingly shown in Table II which presents important facts concerning the 12 boys who received D in patternmaking.

IMPORTANT FACTS CONCERNING TWELVE BOYS WHO RECEIVED D GRADE IN PATTERNMAKING

Student	Vocational Choice	Was patternmaking elected?	Days absent	Intelligence Quotient	Score in final written tests	Construction achievement score, possible 30	Total D's in six major subjects	Total B's and A's in six major subjects	General attitude, interest, industry, comments
2	Clothing	no	7	99	90	4	6	0	poor
4	Engineering	no	19	103	73	3	4	0	fair
5	Auto Mech.	no	13	102	85	3	3	0	poor
11	Store	no	2	90	76	4	2	0	poor
16	Aviation	no	8	106	89	2	3	0	fair
17	Mechanic	no	15	94	75	4	6	0	poor
18	Coast Guard	no	11	112	86	0	4	0	very lazy
29	Engineering	yes	15	88	67	5	6	0	poor
62	Painter	no	1	86	73	6	3	0	fair
69	Engineering	no	8	98	72	1	5	0	poor
76	Merchant	yes	27	91	81	5	3	0	ill
86	Bricklayer	yes	22	90	80	1	5	0	poor

Table II

It will be noted that half the failing boys' vocational choices were nontechnical.

Nine boys took patternmaking against their desires.

Only two have a good attendance record; the others range from 7 to 27 days absence.

The range of I.Q.'s is from 86 to 112, with the mean at 96.66, four points below the general mean.

None of the boys achieved much in pattern construction, the maximum being 6 points in a range 0 to 30.

Every boy had from one to five D's in other school subjects.

None had any grade above C in any subject.

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[2]Toops, Herbert A., *Test for Vocational Guidance of Children*. Teachers College Contributions to Education, No. 136 (New York: Teachers College, Columbia University, 1933), 159 pp.

[3]Board, Edna, Marsh, Willa, and Stockwell, Lynn E., "Relation of General Intelligence to Mechanical Ability," *Industrial Arts Magazine* (September, 1927), 330–32.

[4]Beauchamp, Robert O. and Webb, H. A., "Resourcefulness, an Unmeasured Ability." *School, Science, and Mathematics*, XXVII (May, 1927), 457–65.

[5]McCall, Wm. A., *Correlation of Some Psychological and Educational Measurements*. Teachers College Contributions to Education, No. 79. (New York: Teachers College, Columbia University, 1916), 87 pp.

[6]Witty, Paul A. and Lehman, Harvey C., "Dogma and Biology of Human Inheritance," *American Journal of Psychology*, XXXV (January, 1930), 548–63.

[7]Turney, Austin H., *A Study of Factors Other Than Intelligence that Affect Success in the High School as Indicated by Teachers' Marks* (University of Minnesota Press, 1930), 135 pp.

[8]Thorndike, E. L., "Tests of Intelligence, Reliability, Significance, Susceptability to Special Training, and Adaptation to the General Nature of the Task," *School and Society*, IX (February, 1919), 189–95.

Only three could be said to rate even fair on general attitude, interest, industry; the balance were ill, lazy, or interested only in finding a job to get out of schoolwork.

Based on the discussion of the data in this investigation, and on conclusions by prominent psychologists and other scientific workers, the writer believes that two final conclusions are warranted:

1. It is doubtful that the types of intelligence and ability which make for success in patternmaking are of a kind which lend themselves to measurement by any standardized tests thus far devised; and

2. Some measure of construction ability, regularity in attendance, the presence of proper mental attributes, coupled with interest in the work at hand, attitudes of industry and perseverance, and a seriousness of purpose constitute the most important factors in the success of a student in patternmaking.

Since no standardized tests have been devised for the measurement of these important factors, a study of this type must remain incomplete if it is to be confined to a consideration only of data which are susceptible of rigid statistical treatment.

Certification of Teachers

V. C. Dougherty

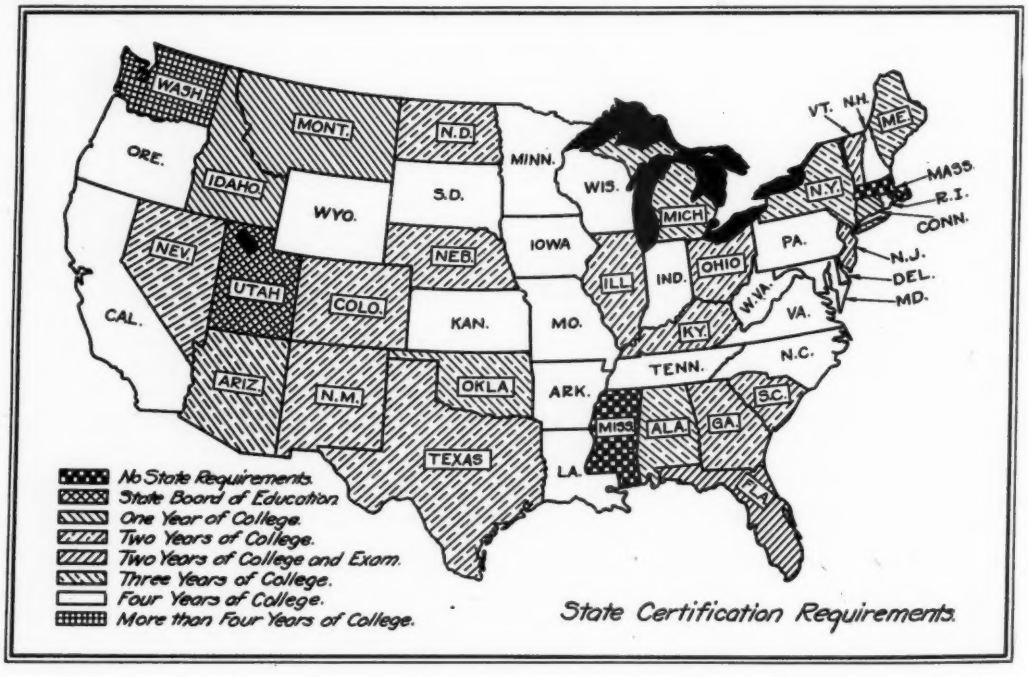
Arsenal Technical Schools,
Indianapolis, Indiana

A comprehensive survey of what the state certification requirements for industrial-arts teachers are in the various states.

THE certification of academic teachers has, in a great measure, been pretty well standardized throughout the country, but for industrial-arts work the requirements are quite varied. In order to determine the certification requirements for industrial-arts teachers in the various states, the author made a study of each state. The information obtained, in each case, was supplied by one or more of the following state officials: State supervisor of industrial education, state superintendent of public instruction, or the director of certification. All information used consisted of personal letters to the author from various state officials, state publications dealing with teacher certification, and bulletins distributed by the state department of public instruction of the various states. In order to more fully understand the trends of the past twenty years, the certification requirements of twenty years ago were also obtained and compared with the present-day standards.

It is interesting to note that each state sets up the requirements which meet its individual needs, and then incorporates with these, the items which are more or less necessary and common to other states in that part of the country. One would naturally suppose that states would group themselves by geographical location, natural resources, and occupations. This was true to a certain extent twenty years ago when the agricultural south and the mining, grazing, and agricultural lands of the west comprised the more backward states when it came to the certification requirements of industrial-arts teachers. This condition is exactly what could be expected as the demands for industrial and mechanical training in these sections would be far below that required in the manufacturing states of the central and northeastern part of the country. The states that required two or more years of college training in 1912 are the ones that stand out as being the leaders, as twenty states had no state requirements at that time, and only one, West Virginia, required four years of college training for certification.

The accompanying map shows the present minimum state certification requirements for industrial-arts teachers based entirely on special college preparation, as that is the way most



of the states certify their teachers. Several states have two or more methods by which one may be certified. One method is always by the completion of a prescribed college course and the other is either by a definite amount of college preparation and a definite amount of trade experience. California, Connecticut, New Hampshire, and New Jersey all allow men with trade experience, who have taken a definite prescribed teacher-training course, to be certified for the teaching of industrial-arts courses in high school as well as those completing the prescribed college course. Illinois, Iowa, and Ohio certify teachers of industrial arts by the presentation of a definite amount of special college training, or a certain minimum college preparation and an examination. The amount of special training in education averages about 15 semester hours. Psychology, practice teaching, and method courses make up the major portion of this requirement. Special training in industrial arts averages approximately 28 semester hours. Some states grant one type of certificate to graduates of their state colleges and normal schools and a less desirable certificate to those who received their teacher training outside the state. The apparent deficiency, however, is always made up by requiring the candidate to take a prescribed number of hours at one of the state institutions before a higher grade of certificate is issued. The average life of the first certificate issued is 2 2/3 years, with the shortest listed at 1 year, and the longest at 6. In practically all states teachers of industrial arts are granted "special" certificates. Special certificates in most states are issued to teachers of music, drawing, home economics, industrial arts, penmanship, physical education, commercial work, and agriculture.

The number of states having no state certification requirements has decreased from 20 in 1912 to 2 in 1932, or a decrease of 89 per cent in the 20-year period. It can no longer be said that the South is backward in its certification requirements, for as a whole, it averages as high as any other section of the country. At the present time the Mississippi Valley and the Middle-Atlantic states embrace the section of the country having the highest requirements. The West is still very irregular in its requirements, due in a larger measure to the very nature of the country. The West does have one very outstanding state and that state is Washington. Washington now demands more in the way of teacher qualifications than any other state in the Union. In the past 20 years, this state has advanced from a position of having no state certification requirements to one where 4 2/3 years of college training are required to obtain any teaching certificate. This is by far the greatest step taken by any of the states in the same unit of time.

Table I is a tabulation of the itemized state requirement for high-school teachers of industrial arts for 1932. The data presented is based entirely on special college preparation as does also the map accompanying this article.

Table I

Type of State Requirement	*Number of States*	*Per Cent*
No state requirement	2	4.167
State boards	1	2.083
One year of college	3	6.250
Two years of college	13	27.084
Two years of college and an examination	1	2.083
Three years of college	6	12.500
Four years of college	21	43.750
More than four years of college	1	2.083
Totals	48	100.000

At the present time almost half of the states, or 43.75 per cent, now require four years of college training before a person is eligible for certification. This is indeed a marked growth from a mere 2 per cent in 1912. The foregoing table clearly shows that the 2-year and 4-year special college courses are the basis for most of the certification requirements of the various states. Massachusetts and Mississippi are now the only two states that do not have some form of state certification for industrial-arts teachers. Massachusetts allows each community to certify its teachers, while Mississippi depends upon engineering graduates, in the main, for their industrial-arts teachers. In Utah, the state board of education grants certificates to candidates who satisfy the board that they have the necessary qualifications and training to teach the work in which they are asking to be certified. A few of the states, the western ones in particular, now require applicants for teaching certificates to present college credit or pass an examination in one or more of the following courses, namely: United States constitution, state constitution, state school law, and state history. Table II, shown above, gives the names of the states, the courses required, and the methods by which the special social-science requirement can be met.

Table II

State	*United States Constitution*	*State Constitution*	*State School Law*	*State History*
Arizona	Examination or College Credit	Examination		
Florida				
Idaho			Examination	
Kansas			College Credit	
New Mexico				Examination or College Credit
Texas	College Credit	College Credit		
Wyoming	Examination or College Credit	Examination or College Credit		

Principles of Design—II

Franklin H. Gottshall

West Lawn, Pennsylvania

The second in a series of articles on the important subject of design. In this issue the subject of curved lines and elements and their application to outline enrichment is discussed.

IN THE first article of this series, rules were given for effectively dividing large areas on a primary mass to enhance beauty. The importance of these rules becomes self-evident when one sees objects that have little or no appeal, because of the lack of such planning. The sins of improper space division are many, but they are as nothing when compared to the transgressions practiced against beauty by improper outline enrichment. Therefore, our second study in the field of design will be about curved lines and elements, and their application to outline enrichment.

Objects in which straight lines alone are used may be beautiful if well proportioned, properly ornamented, and made of fine materials. The Chinese have designed some remarkable cabinets and other pieces, which show no curves in their structural outlines. There is really nothing new about ultra-modern design. It follows rules and precepts that are in some cases thousands of years old. It may be admitted, therefore, that pleasing form is possible when straight lines alone are

used, but the field of possibilities is infinitely greater if curved lines are also used.

On a piece of pottery, metal work, or jewelry, it is sometimes possible to use curved elements almost exclusively and thus make an object of utility and refinement (see Fig. 11). In furniture design this is not always possible. Pieces in the Louis XV style, particularly chairs, were sometimes designed so that not a single straight line was used in their entire composition. Figure 2 shows a Hepplewhite chair of Louis XV design in which this has been done. This is high art, and the piece shown possesses exquisite grace and refinement. The eye derives pleasure from beautiful curves, especially when they are used in the enrichment of outlines. They bring freedom and grace to a design that is not possible when straight lines alone are used. The straight line imposes too many restrictions upon a designer, who, if he is a real artist, will use firm, free-flowing curves to enhance the beauty of his creations.

FIG. 11
Silver Cup
CURVED LINES ARE SUPREME ON AN OBJECT OF THIS KIND.

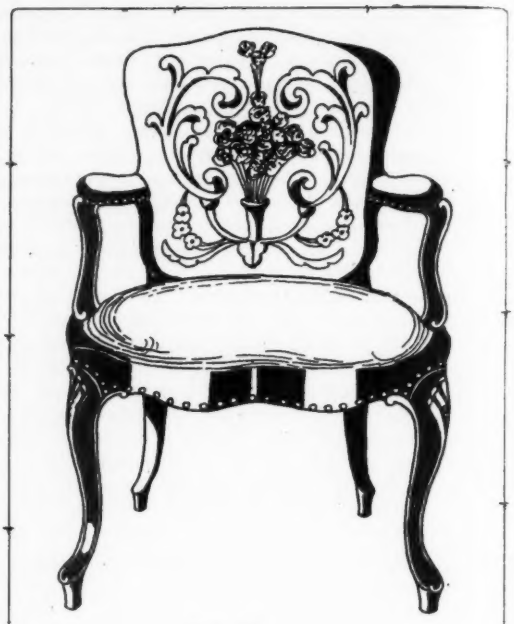


FIG. 12
Louis XV Chair
A PIECE OF FURNITURE ON WHICH THE OUTLINE IS COMPOSED OF WELL EXECUTED COMPOUND CURVES.

A desire to use curves in outline enrichment is apparent in the work of every amateur. It is sometimes expressed in the meaningless scrolls of an apron on a stool, or, what is worse, with mechanical curves drawn with a compass or some other device. The amateur's lack of ability to design beautiful outlines is due to improper thought in some cases, but more often to a lack of proper training. Mechanical curves have their place in design, but should be sparingly used. They lack the essential element found in all good design, which is intriguing variety. Poor design is the result of monotony brought about by mechanical effects — mechanical curves, mechanical repetition of identical elements, mechanical proportions, etc. Good design results from avoiding these things.

An examination of the curves used in the enrichment of outlines, as well as in surface enrichment, which will be treated in a later article, will reveal four distinct types of curves. They are: the compass curve, the freehand one-direction curve, the reverse curve, and the compound curve. Each of these, with the exception of the compass curve, offers opportunities for great variety.

The compass curve and its applications. Compass curves may be used in outline enrichment to round corners, and occasionally in Colonial or provincial designs to secure quaint effects. An interesting example of a piece in which this was done is shown in the design of the bookshelf in Figure 13. The

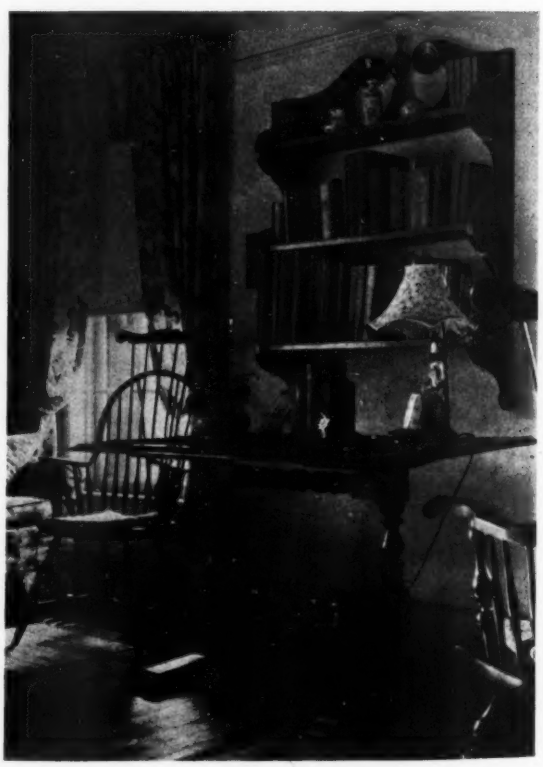


Fig. 13. Showing application of curves

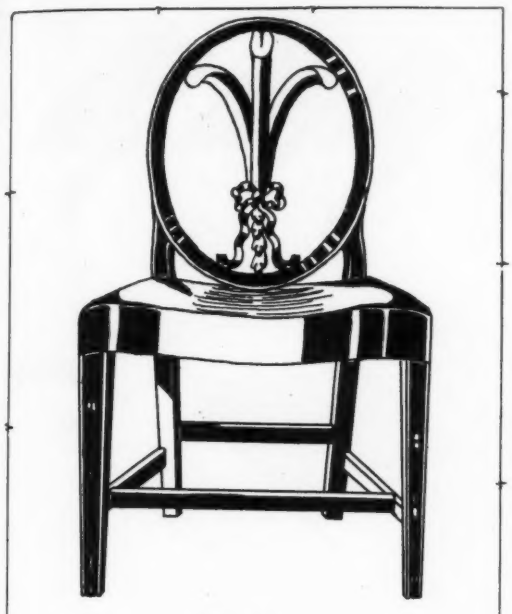


FIG. 14
Hepplewhite Chair
AN OVAL BACK SHOWING THE ONE-DIRECTION CURVE BEING EFFECTIVELY USED IN OUTLINE STRUCTURE.

mechanical effect is, however, alleviated by the free-hand curves found elsewhere on the design.

The one-direction curve and its applications. The most beautiful curves are firm, freehand curves, which unfold themselves with grace and rhythm. The one-direction free-hand curve, which is also the simplest of them all, has great possibilities. The limits of its possible variation are the straight line, and the circle. It is the curve found in the oval; a motif used with such excellent effect by Sheraton on many of his designs, and by Hepplewhite on some of his finest chair backs (see Fig. 14). It is the curve used in the design of the scroll found on the Ionic column: an element of great renown and refinement, especially as used by the Greeks. This scroll is shown adapted to three different uses in Figure 13. It is used at the top of the bookshelves, at the top of the Windsor chair, and on the arm of the other chair. It is also exploited in the design of the mirror frame shown in Figure 15. A very important one-direction curve is the one known as the "curve of force," an example of which is shown on the inside of the leg of the small fireplace bench in Figure 16. This curve always begins with a gentle sweep and ends with a more sudden though rhythmic curl. It is a supporting curve,

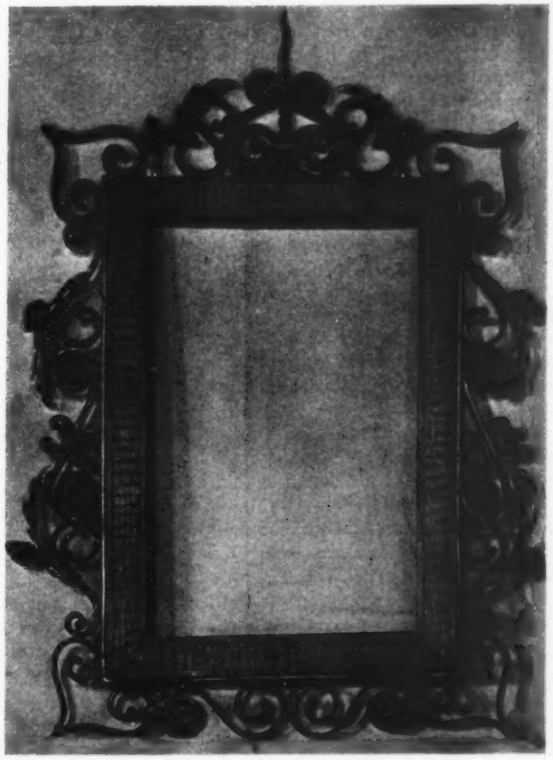


Fig. 15. Showing application of reverse curves

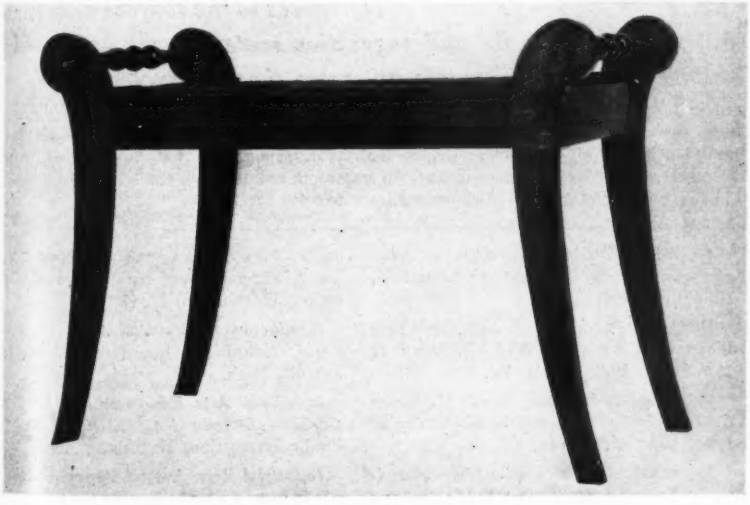


Fig. 16. Showing application of the curve of force

and is frequently found on beautiful turnings, and in other places, in its pure or modified form. A beautiful one-direction curve should have no straight line in its composition and although the curve at times may be very elusive, this rule should not be broken.

The reverse curve and its applications. Reverse curves even though poorly formed, usually appeal to our sense of beauty. This is true of this type of curve more than of any other curve used in design. The design of the mirror frame (Fig. 15) proves it. The reverse scrolls on the sides of the mirror frame have straight lines in the center, but appeal to our sense of beauty almost as much as the others that do not have this fault. The latter are, of course, superior curves. The applications of this curve to indus-

trial-arts design are innumerable. It is the curve used on cabriole legs of the Queen Anne, Chippendale, and Louis XV styles. It is found on beautiful turnings, beautiful metal work, and wherever designs are drawn. It is always most beautiful if the curve is sharper on one bend than on the other.

The compound curve and its applications. The compound curve is the one with which the designer will have the greatest difficulty. It is compounded of two or more of the more simple curves. If well executed it is very effective, but using it on a design requires a great nicety of judgment. Its use, more than any other element found in design, will reveal the true ability of the designer. A compound curve, to be effective, must not be a meaningless scroll, but must express its function in a definite manner. This rule is clearly illustrated by the design of the chair in Figure 12.

Turnings and moldings. Turnings that are designed with beautiful curves, according to the rules just given, are always superior to the haphazard designs which one so often finds. Good turnings always have beautifully formed curves. Some of the things that make turnings beautiful are:

1. The curves must be full and well rounded, rather than scant and flat. This gives an impression of richness and sufficiency of material not found in thin cheap turnings.
2. Curves should connect with fillets to form as near a right angle as possible. This should also be the case on moldings and other outline structures. This makes the change in direction definite, and leaves a clean-cut, satisfying profile.
3. Monotonous repetition of identical elements should be avoided. The compound molding shown at (H) in Figure 18, is attractive largely because these rules have been carefully obeyed. The beauty of the objects in Figure 13 is due largely to the clear-cut, attractive, outline structure. Such pieces are far superior to those on which curves are weak and flat, or monotonous, resulting in a very ordinary product.

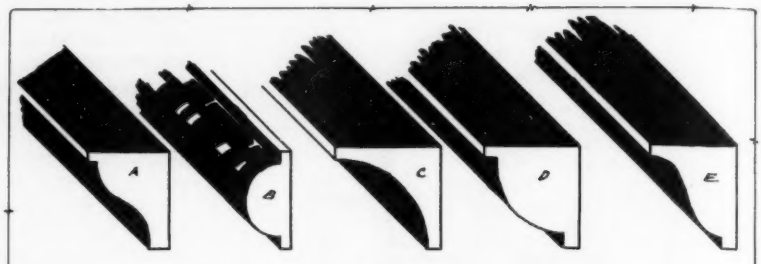


FIG. 17
Simple Mouldings

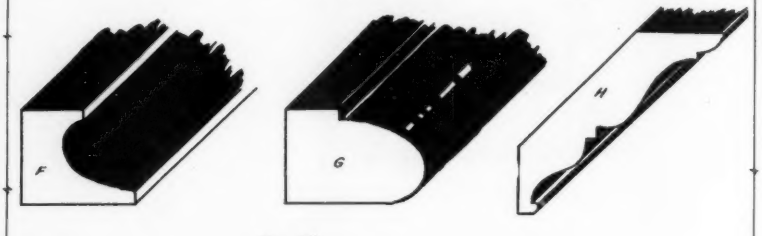


FIG. 18
Refined Mouldings

The moldings shown in Figure 17 are the simple moldings found in architecture. They constitute the alphabet of moldings, and of form. In Figure 18, are shown several that have been refined by redesigning the curves, or combining them with others to make them more interesting and serviceable. The curves on the latter are all freehand curves to which the rules of good design have been applied.

Aids for the School Shop

Carl V. Lindemann

Paw Paw, Michigan

This list of references to the sources of helpful and suggestive material will be found valuable by many shop instructors.

MANY of the educational bulletins contained in the following list contain material that will be found useful in the preparation of instructional or reference material for use in the school shop. Much of it has been prepared at great expense by industrial concerns who are glad to see it used in the school. Some of it contains priceless information on raw materials, methods of manufacture, methods of transportation that can be used as excellent material for classroom discussion in the school shop. Many of the items listed are free for the asking.

Educational Bulletins

Two-Year Course in Machine Shop for Senior High Schools. Department of Vocational Education, State Dept. of Public Instruction, Lansing, Mich.

Teachers Training. A collection of instructional sheets, and other material. Division of Trades and Industries, State Board of Vocational Education, Columbus, Ohio.

Teaching Units in Machine-shop Practices — Outline of Vocational Guidance. Depart. of Trades and Industries, Soldiers and Sailors Orphans Home, Xenia, Ohio.

A Guidance Program Based on the Value of Industrial Arts. Board of Education, Hamilton, Ohio.

Desirable Outcomes of Industrial Arts Woodwork in Junior High. Parkway at 21st Street, Philadelphia, Pa.

Validating and Testing Home Mechanics Content. Louis V. Newkirk, University of Iowa, Iowa City, Iowa.

Industrial Arts Education in Pennsylvania. State Department of Public Instruction, Harrisburg, Pa.

A Course in Farm Shop Work for Teachers of Vocational Agriculture. Monograph No. 5, Federal Board for Vocational Education, Washington, D. C.

Handbook on Industrial Arts and Vocational Education. Board of Education, Detroit, Mich.

Industrial Arts Education in the 7-8-9 Grades — Bulletin No. 4. Department of Public Instruction, Harrisburg, Pa.

Industrial Arts. Annual Report, Division of Industrial Arts, Board of Education, Philadelphia, Pa.

Industrial Try-Out and Finding Courses.

A. C. Tagg, Bulletin of the Fordson Public Schools, Dearborn, Mich.

Inside Information About Your Car. Standard Oil Company of Indiana, Chicago, Ill.

Micrometer Chart. 10 by 12 in. The Lufkin Rule Co., Saginaw, Mich.

The General Shop and Household Mechanics. A bulletin dealing with the problems of the general shop. One of the best on this subject. Industrial Arts Monograph, Dept. of Public Instruction, Dept. of Vocational Education, Lansing, Mich.

The Rural Farm Shop in the Consolidated Schools. A bulletin dealing with the problems of the farm shop in the small consolidated school. Very good. Dept. of Public Instruction, Rural Education Division, Lansing, Mich.

Standards of Attainment in Industrial Arts Teachers. This bulletin sets up certain standards in industrial arts. American Vocational Association, Indianapolis, Ind.

A Suggestive Course of Study in Home Mechanics for the Grades. Carl V. Lindeman, Western State Teachers College, Paw Paw, Mich.

Graduate Theses and Dissertations in Industrial Education and Vocational Education Accepted by Institutions of Higher Education in Iowa. This bulletin gives a list of theses. The first of its kind. Prepared by William Hunter, Dept. of Industrial Arts, Iowa State College, Ames, Iowa.

A Suggestive Course of Study in Manual Arts for North Dakota. Carl V. Lindeman, State Normal and Industrial College, Ellendale, N. Dak.

Manual Arts in the Junior High School. Industrial Education Circular No. 15, Dept. of the Interior, Washington, D. C.

Provisional Course of Study in Manual Arts. Department of Education, St. Paul, Minn.

Vocational Education as a Preventive of Juvenile Delinquency. By Arthur F. Payne, University of Minn., Minneapolis, Minn.

Bibliography of Industrial Publications. State Board of Vocational Education, State House, Columbus, Ohio.

Character Education in the School Shop. Carl V. Lindeman, Western State Teachers Training Unit, Paw Paw Public Schools, Paw Paw, Mich.

Motion Picture and Illustrated Lectures. The General Electric Co., Schenectady, N. Y.

Information Topics in Woodwork. Carl V. Lindeman, Western State Teachers College, Paw Paw, Mich.

Objectives of Industrial-Arts Education. 75 pages, heavy paper bound. Statements of 138 leaders in industrial-arts education regarding the purposes of the several phases of industrial-arts education. Price, 75 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Test Questions in Industrial Arts Education. 100 pages, heavy paper bound. Objective test questions and answers for mechanical drawing, woodwork, metal work, electricity and printing. Price, 75 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Poems for Teachers of Industrial-Arts Education. 102 pages, heavy paper bound. More than 200 poems which will appeal to craftsmen and teachers. Excellent as source material in printing. Price, 75 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

A Guide to Woodworking Problems. 30 pages, heavy paper bound. A handy index to more than 400 problems in woodwork found in magazines and books most used by industrial-arts teachers. Price, 30 cents, postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Technique of Teaching Trades. 100 pages, heavy paper bound. A collection of the best methods and devices for use in trade education. Designed for use in teacher-training classes. Price, 75 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Annotated List of 800 Graduate Theses and Dissertations in Industrial-Arts Education and Vocational-Industrial Education Accepted by Institutions of Higher Learning in the United States; 1892–1933. 90 pages, heavy paper bound. Of especial value to those engaged in research or in directing research. Price, 75 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Books Commonly Found in Industrial Arts Libraries in Iowa. 9 pages, heavy paper bound. Approximately 100 titles of books most commonly found in the industrial arts shops of Iowa. Price, 10 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

Annotated List of Graduate Theses and Dissertations in Industrial-Arts Education and Vocational-Industrial Education Accepted by Institutions of Higher Learning in Iowa. 13 pages, heavy paper bound. Eighty authors with the titles of their theses. Price, 15 cents postpaid. Industrial Arts Dept., Iowa State College, Ames, Iowa.

(1) *Suggestive Course of Study in Electricity.* (2) *Suggestive Course of Study in Auto-Mechanics.* Carl V. Lindeman, Paw Paw, Mich.

Bulletins

(1) *Bearings and Their Lubrication.* (2) *Correct Automobile Lubrication* (free). Vacuum Oil Company, New York, N. Y.

The Design Book (Chests, Lamps, Gate-Leg Tables, etc.), (free). Kuempel Company, Guttenberg, Iowa.

Fancy Cabinet Woods and Their Uses (free). Albert Constantine & Sons, 780 E. 138th, New York City.

How to Repair and Refinish Furniture (free). The Savogran Co., Boston, Mass.

Starrett Book for Machinist Apprentices (free). L. S. Starrett Co., Athol, Mass.

Plywood Project Book (free). Algoma Panel Co., Algoma, Wis.

Hobby Booklet (free). Practical Arts Publishing Co., 44 Vista Ave., Elizabeth, N. J.

The Evolution of the Lathe (free). The Lodge and Shipley Machine Tool Co., Cincinnati, Ohio.

Wood Screws (free). American Screw Co., Providence, R. I.

Elementary Electrical Construction for Junior High School, Bulletin No. 224 (free). State Board of Control for Voc. Education, Department of Public Instruction, Lansing, Mich.

(1) *Handicraft Club Work, Bulletin No. 11A.* (2) *Handicraft Club Work, Bulletin No. 11B* (free). Michigan State College of Agriculture and Applied Science Extension Division, Lansing, Mich.

The Romance of Industry (free). Chas. M. Higgins Co., 271—9th St., Brooklyn, N. Y.

(1) *How to Grind Valves, Bulletin No. 1.* (2) *How to Make a Bushing, Bulletin No. 7.* (3) *How to Service Armatures, Bulletin No. 9.* (4) *Machine Shop Course, Bulletin No. 55A.* (5) *Auto Service Job Manual, Bulletin No. 56.* (6) *How to Machine Fly Wheels, Bulletin No. 3* (free). South Bend Lathe Works, South Bend, Ind.

Weddell Book of Projects (free). Weddell Mfg. Company, 1135 Taylor Avenue, N. W., Grand Rapids, Mich.

Information on Ornamental Ironwork (free). J. G. Braun Co., 597 W. 35th St., New York City.

Aluminum and How to Solder it (free). L. B. Allen Co., Chicago, Ill.

How-To-Do-It Book. 10 cents. E. C. Atkins & Company, Indianapolis, Ind.

The Finishing Touch (free). Martin Varnish Corp., Chicago, Ill.

Cold Facts About Glue (free). Sure-Grip Adhesives Inc., Albany, N. Y.

Red Book on Casco Water Proof Glue (free). The Casein Mfg. Co., New York City.

What You Can Do With Plastic Wood (free). A. S. Boyle Company, Cincinnati, Ohio.

Manual on Wood Finishing (free). Grand Rapids Varnish Corp., Grand Rapids, Mich.

The Story of American Walnut (free). American Walnut Mfg. Co., Chicago, Ill.

Chats on Period Style in Furniture (free). Yates-American Machine Co., Beloit, Wis.

Instructions in Making Blue Prints (free). C. F. Pease Co., 802 N. Franklin, Chicago, Ill.

Shellac, A Story of Yesterday, Today, and Tomorrow (free). James B. Day Company, Chicago, Ill.

(1) *The Proper Treatment for Floors and Furniture.* (2) *Job Sheets on Wood Finishing* (free). S. C. Johnson and Sons, Racine, Wis.

Hack Saw-ology (free). Simonds Saw & Steel Co., Fitchburg, Mass.

(To be continued)

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

J. J. Metz, Editor

Purchasing Lumber for the School

While economic conditions show improvement and while pressure on the school has been reduced to some extent, nevertheless the most careful attention to school-shop economies is still extremely necessary.

For the woodshop instructor whose reduced budget of last year may have to be still further reduced for the coming school year, the question of lumber prices now effective under the NRA Code may seem thoroughly disheartening. Even in those cases where the pupils buy their own materials, it is well for the instructor to study the matter of lumber prices very carefully because the students' ability to pay has not been improved appreciably over what it was during the past several years. A little discussion therefore of what a school or school system can do in order to supply its lumber requirements as economically as possible is opportune.

The first item that deserves scrutiny is the grade of lumber bought. Inquiries show that this item alone costs many school systems a great deal of money each year, because most teachers habitually order only the best grade of lumber. Every instructor of woodworking ought to be familiar with the grading, measurement, and inspection rules as they are applied to lumber. Of course, there can be no permanent grading rules, as adjustments between existing lumber supplies and quality must be made continually. Information on this important subject, however, can be obtained from an article on "Hardwoods in the Schools," by Edgcomb, on page 88 of the 1930 edition of *Bruce's School Shop Annual*. The National Hardware and Lumber Association, Straus Building, Chicago, Ill., also distributes information on grading which covers hardwood, cypress, veneer, plywood, and thin lumber.

Since most school projects require short lengths of lumber, it is unnecessary to demand that all lumber should be of the longer standard lengths. By ordering lumber of the Grade No. 1 shop common and better, short and uneven lengths and odd widths will be obtained. This lumber is not adapted to the regular commercial trade but is very suitable for schoolshop use. Then, too, blemishes can be cut out of the shorter pieces with less loss. As to grade, the average school shop will save considerably if the order is made out for No. 1 common and better rather than for No. 1 and clear stock. It is well, of course, to insist that the National Lumber Manufacturers Association grading rules be used rather than the grading rules set up by some local lumber dealer. The next important thing to remember is that lumber is cheapest when bought in carload lots. This, of course, cannot be done in the small community, but any system that uses between 18,000 and 25,000 board feet of lumber during the year, should not fail to make use of this extra opportunity in buying its lumber supplies because in lots of this size, wholesale prices can be obtained.

Another point that should be taken into consideration is the economy of limiting the kinds of lumber to be ordered. It is well to cut down the number of kinds of wood used as much as possible. Some schools, for instance limit themselves to buying three different kinds: one hardwood, one of medium hardwood and one of soft, easily worked wood. It is well also to limit the kinds of lumber to be ordered, to those cut in the locality of the mill from which the lumber is obtained. When lumber has to be shipped great distances it naturally will cost more. Of course, restricting the lumber supplies to three or four kinds may make it necessary for some students to buy some of the higher-priced woods locally, but it is better to do this than burden the taxpayer with the cost of higher-priced material. It is well to remember that fine woods add to the beauty of the finished piece but they add nothing at all to the instructional value of the work. Under most conditions, however, white oak can be obtained almost anywhere; and white oak ranks high as a fine cabinet wood.

It is well to remember that under the NRA there are two codes for the lumber industry: one governing the manufacturers of lumber and under which the wholesale and commission men operate, and the other which the retail lumber industry operates. The first one is called the code for fair competition for the lumber and timber-products industries, and the other is the code which governs lumber and building-material-supplies industries.

The operations of these codes are little understood by most people and they may be subject to further modifications as conditions may suggest, but at present the retail lumber code has no jurisdiction over carload quantities shipped directly from the mill in one lot intact, and in one delivery. Therefore, retail lumber men as well as the manufacturers, wholesalers, and commission men may quote the school wholesale prices on carload lots.

Shop Safety and First Aid

Again the school-shop teacher is confronted with the task of seeing that the students who enter his classes to learn how to do things with their hands, also learn to do these things safely. He must therefore plan a real safety program to go with his practical work. Safety instructions, however, can easily and naturally be combined with the study of first-aid practices.

The safety program, therefore, should be expanded to contain training in the proper use of first-aid materials and first-aid practices. The shop student should be impressed with these general facts:

1. That he should know how to give first aid;
2. That if the injury is at all serious, the doctor should be called or the patient should be taken to the doctor even though first aid has been given;
3. That it is better to call the doctor and do nothing more if one is not perfectly sure what ought to be done (this emphasizes the necessity of knowing what

to do, referred to in No. 1);

4. In applying first aid, the student should be trained to act with calmness. Much harm can be done by one who is acting hastily and unthinkingly.

Supervised Correspondence Study

Recently a three-day conference on supervised correspondence study was held at Teachers College, Columbia University. Under present-day conditions where thousands of boys and girls are graduated from high school without an opportunity of obtaining work the supervised correspondence study method deserves earnest consideration not only by the small rural-high-school authorities but by many city school systems as well.

There is grave danger that the young men and women graduating from our high schools and unable to secure employment, will build up wrong habits of living if permitted to remain idle after school supervision in their lives has ceased. Many of them can be influenced to come back to school if worth-while courses are arranged for them. Under present economic conditions, any extension of work that can be thought of for the rural and small-city school systems must be something that does not cost a great deal of money. The correspondence method fits very well into this scheme because it enables one teacher to supervise a great number of students. Practically all that is required is a room where students of this kind can be accommodated, and the work can be started at once.

The large number of practical and theoretical courses offered by correspondence schools and university extension divisions opens up an immense field for these young men and women to choose from. By adopting the supervised correspondence study method, the school will do much in furthering a real educational endeavor, at the same time helping thousands in making a better preparation for a useful future and in developing habits of work rather than of idleness with its usual concomitant — a life of dependency or of crime.

After the Start Has Been Made

With the new school year actually begun, the shop teacher must not forget that even if he did carefully plan ahead so that the work of the new year could be started in the proper manner, his work, if it is to be successful, will require still more planning.

There are, for instance, his relations with the students. Adolescents are quick to perceive and to take advantage of any weakness in the teacher's personality. It is important, therefore, during the first week or two of school to make the right impression upon the students. There must be ample evidence that the teacher is anxious to be friendly but that he will not permit undue familiarity, that he means exactly what he says, that he is not stern, but firm, that there are no special privileges except for those who have earned them, that there is but one rule which applies to all.

He must carefully study each student to learn as much about the individual as possible. There are those who need much assistance and encouragement in order to get along — there are others who must get treatment that is quite different.

Then, there are the relations between the teacher and his fellow teachers. Here again, the shop teacher must make it plain that his co-operation with other members of the faculty must not interfere with the work or efficiency of his department. There are some teachers who would have the shop continually engaged on jobs for them. There are others who continually want to borrow tools. Both of these classes of teachers must be tactfully but firmly informed of the conditions under which their wishes can be acceded to — or of the impossibility of complying with their desires.

Then plans must be laid for systematically recording needed changes in instructional material that has been found to be inadequate in some point or other. The proper time to record these suggestions is when the need for the alteration is first discovered. Unless these notes are made at once, the rectifying of the discovered weakness may be, and usually is, forgotten.

It is the same with changes and replacements of equipment, materials, and supplies that may become necessary. Steps must be taken for correcting defects or necessities as they occur, otherwise the ghosts of forgotten duties may arise to vex and trouble the careless teacher at most embarrassing moments.

Another point to be remembered is that all of a teacher's classes can well be molded into a whole by arousing an interclass competitive spirit through comparative class-attendance charts, progress charts, grading charts, and the like. In the same way, interclass competitions of various types can be arranged, which will assist greatly in making the work more interesting and more appealing to the student.

Then there are clubs of various types which may be started for carrying on a variety of types of work. Some of these club activities have been described in past issues of this magazine. Among them may be mentioned hobby clubs, model-airplane clubs, model sail- and power-boat clubs, class-presentation project clubs, equipment-maintenance clubs, radio clubs, home-workshop clubs, clubs that make a specialty of building stage settings, painting scenery, building electrical equipment for producing sound and light effects for the stage, and the like.

The shop teacher also can do much for himself, for his classes, for his school, and for the home craftsmen in his community by taking an active interest in the craftsmen's guilds that are springing up all over the country. His contacts with men who are making a hobby of doing various types of work in home workshops will give him an excellent opportunity to extend his sphere of usefulness, and at the same time offer him a chance to give industrial-arts work in the school an enviable reputation.

Of course, all of the foregoing suggestions require extra time and extra effort, but the energy expended upon them will be well spent because it will be a means of popularizing industrial-arts work, something which is so necessary especially at the present time.

High-School Mechanical Drawing

H. D. Campbell

J. Sterling Morton High School,
Cicero, Illinois

The writer of this article ably shows how mechanical drawing may be taught so that it no longer is a special subject but a real part of general education.

THE economic crisis through which we are passing has focused public attention upon education. The social philosophy now emerging cannot fail to modify our old educational philosophy which assumed that the goal of secondary education was equal opportunity for all to enter college. It is not unlikely that education in the future will acknowledge the inequality of opportunity and ability, and the injustice done to the majority in offering to all the advantage of an education by which only the privileged minority could fully profit.

An evaluation of the traditional elements of the curriculum in terms of social utility, may be expected to result in lessened emphasis on some, increased emphasis upon others. Terminal courses in the senior high school must be established to meet the situation recently created by the virtual withdrawal of the opportunity for urban employment before the age of eighteen. These terminal courses will include preparation for entry into industry and will give to senior-high-school shopwork the justification for existence which has not been previously demonstrable to the satisfaction of its critics both within and without the schools.

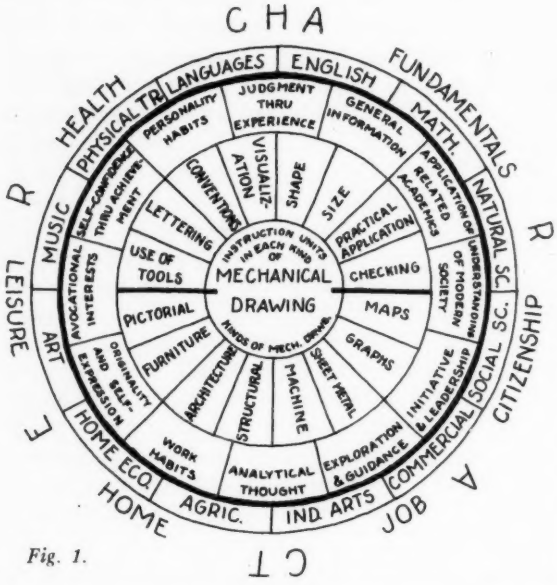


Fig. 1.

The intelligent choice of an industrial trade course can best be made by a junior-high-school graduate who has profited by the exploratory and guidance values of industrial arts courses—obvious values which furnish the best defense of junior-high-school shopwork against the "fad-and-frill" accusation of the layman. Among schoolmen, however, it is becoming widely recognized that industrial-arts and industrial trade courses have a considerable contribution to make toward general education as will be shown in the case of mechanical drawing (see Fig. 1).

Mechanical drawing in secondary schools includes eight principal subdivisions: furniture, sheet metal, machine, structural, architectural, and pictorial drawing and the making of graphs, charts, and diagrams. Each subdivision, taken by itself, requires instruction in use of tools, lettering, use of conventions, visualization, shape description, size description, practical application, and checking.

There are many benefits to be derived from instruction in mechanical drawing. To all students, a socialized course in drawing has values in exploration and guidance, general information, application of English, mathematics and natural science, and a better understanding of modern society. To the student primarily interested in shopwork, drawing aids originality and self-expression along avocational lines, and is an essential tool in most trades.

To the student who takes advanced work in a vocational department where squad organization is employed in designing projects to be built in the shops, mechanical drawing promotes initiative and leadership, pleasing personality habits, analytical thought, correct work habits, self-confidence through achievement, and judgment through experience.

Drawing alone has no monopoly on these educational values but shares them with the other divisions of the curriculum: English, mathematics, natural and social science, foreign languages, industrial arts, home economics, commerce, agriculture, art, music, and physical training. It is only through the combined efforts of all the agencies to which students are exposed that the seven cardinal aims of education are achieved. Figure 2 indicates the contacts which mechanical drawing makes with the major divisions of the curriculum.

Maps and charts are read or made in many subjects, and a few lessons in their making in a junior-high-school general-mechanical-drawing course are of value to all. English teachers commonly motivate oral and written expression by reference to all forms of student activity including drawing. Drawing teachers, in return, should require the use of correct English in titles, notes, recitations, and written work. In social science, the vocations course includes study of the professions and trades which should also be touched upon by teachers of drawing. Many problems in sociology and economics, such as urban congestion, technological unemployment, the industrial revolution, and the business cycle, may be made more vital by an acquaintance with architectural and machine drawing if these subjects are taught with an appreciation of their social values. In the natural sciences, a knowledge of topographical drawing is of value in physiography, and vice versa. Architectural and machine drawing make much use of practical applications of the laws of physics and

Fig. 2	Kinds of Mech. Drawing							
Divisions of the Curriculum	Maps	Charts	Architectural	Furniture	Machine	Sheet Metal	Structural	Pictorial
English	✱	✱	✱	✱	✱	✱	✱	
Social Science	C	C	C	C	C	C	C	
Natural Science	✱	C	/	/	/	/	/	
Mathematics	/	✱	/	/	/	/	/	
Agriculture	C	C	C	C	C	C	C	
Art	C	C	✱	✱	C	✱		✱
Industrial Arts	C	C	✱	✱	✱	✱		
Home Economics	C	C	C	C	C			
Commercial	C	C						
Languages	C		C					
Physical Training		C						
Music								

✱-Includes all forms of drawing (except architectural) relating to woodwork.
C-Contribution from drwg. to another subj.
/-Contribution from another subj. to drwg.

some connection with chemistry. The relation between mechanical drawing and mathematics is, of course, obvious.

Nearly all kinds of drawing find practical application in agriculture, even structural drawing, now that steel-frame barns are beginning to appear. One of the later developments in decoration combines art and cartography in pictorial maps. The art department is often called upon to prepare decorative charts and graphs. Art and mechanical drawing have a common ground in architectural rendering and in the design of furniture, ornamental metal work, etc. One branch of commercial art derived from machine drawing is followed by those who specialize in preparing the pictorial representation of machines and machine parts for catalogs and instruction manuals. The desirability of correlation between drawing and the shops may be taken for granted. Furniture, sheet metal, and machine drawing have the highest factors of correlation except where the building trades are taught through actual cottage construction, in which case architectural drawing may be added to the list. Plot plans and maps of the district, charts of enrollment and costs, and wiring and piping diagrams are often required of the drawing division outside the regular instruction work. Home economics and mechanical drawing should have closer contacts than usually exist, since it is the girl, rather than the boy, who will plan the home or select the apartment, choose the furniture, and operate increasingly complex household appliances. The language and drawing divisions have some contact through a common interest in the famous buildings of Europe described and illustrated in drawing-class talks on the history of architecture. Even in physical training there is a slight connection with drawing in the reading of diagrams of playing strategy in "skull practice."

A general course in mechanical drawing presents many avenues of approach to one of the goals of education—the job. Figure 3 suggests the opportunities open to the boy who later specializes in machine drawing. The graduate whose training qualifies him for entry into industry as a junior may enter the drafting rooms of the engineering, maintenance, tool, or production departments. When he is sure of his interests and abilities, he can remain and work his way up, or transfer to the drafting room of another department, or to the offices, personnel division, shops, inspection, or sales division. His association in the drafting division with engineers and executives presents many opportunities for finding the

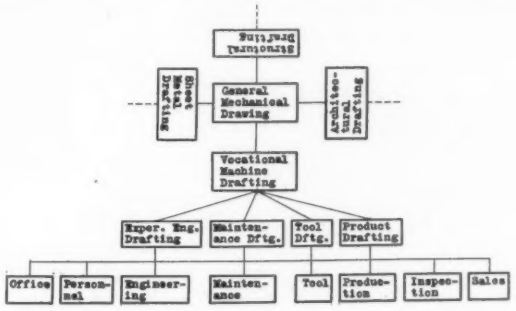


Fig. 3. Diagram showing to what machine drawing may lead

place he can fill with the greatest degree of success and happiness.

In conclusion, it may be said that for a large part of the school population, few subjects have a higher value than mechanical drawing, either in general or specific preparation for active participation in the life of the modern community.

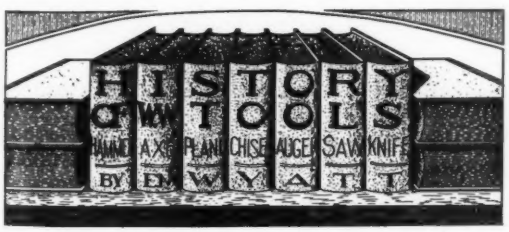
Common Woodworking Tools—I

E. M. Wyatt

West Technical High School,
Cleveland, Ohio

This is the first of a series of interesting historical sketches of the development of woodworking tools. This material may well be added to the related-subjects matter already used by many woodworking instructors.

IN A phrase often quoted, Carlisle has pointed out that man is the only animal that uses tools. Man's ability to make and use tools is probably one of his chief claims to superiority over his contemporary creatures. Yet this tool-using ability must have been acquired. It is but idle guessing to try to explain how he learned to use inanimate objects to supply his wants or what those first helping objects were. We can rest



assured, however, that they were first the objects he found in nature ready for his purposes, and later those that he modified in some way to better fill his needs. These latter can properly be called tools.

"We speak well of the bridge on which we crossed," is a generally accepted adage. If we accept it, we should speak reverently of the tools that gradually but steadily transformed primitive man into the being that devised the radio wherewith he can speak to the entire earth, and who even dreams of speaking to the planets.

Truly man's lordship over the other creatures of the earth is due not a little to his ability to take things in nature and turn them into simple tools, with which in turn other tools may be made to be used for producing greater tools, which may be used for producing super tools. Yet how little of history concerns itself with the means of man's achievement. So many of its pages are but recording the strife of man with man—tales of one group tearing down the achievements of other groups. Surely such is not the proper story of man's climb to civilization.

More truthfully the significant history of man reads like this: By conquest of the club, the stone hammer was conquered; by conquest of the hammer, the drill was conquered; by conquest of the drill, the wheel was conquered; by conquest of the wheel, the lathe was conquered; by conquest of the lathe, the steam engine was conquered; by conquest of the engine, the electrical age was achieved; all because primitive man learned that he could strike harder with a club than with his fist.

If history really recorded such important items as these, my task of telling the story of our common woodworking tools would be so much easier that it might not be necessary at all. As history is recorded, there are many blank pages as

far as the story of tools is concerned, and on others the material is as scrambled as a jig-saw puzzle. I have undertaken the task to gather this material and to arrange it in illustrated form in the hopes not only that it will be of interest, but that it will create a reverence for that scepter of power—*tools*—that has made man superior to the other creatures of earth.

The Hammer

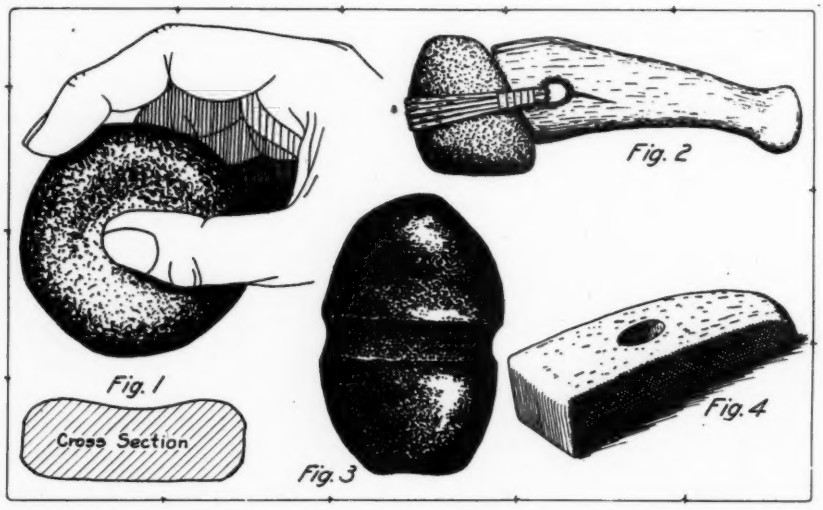
The history of tools can very logically begin with the hammer, for all indications are that it was among man's first tools. Indeed, we have every reason to believe it to be the oldest tool whose remains we find today. These first hammers were but brook pebbles that primitive man picked up to help break open mussels, nuts, and bones in his quest for food. Later he learned to use them to break or flake other stones in shaping them into weapons or into other tools. Since they were selected for convenient fitting of the hand, they frequently had thumb depressions as has the simple pounding implement shown in Figure 1. They vary in size and shape but always fit the hand and frequently show wear on the striking face. Many that heve been found have quite evidently had their shape intentionally modified by striking, or pecking, and rubbing with other stones. Archeologists call these handleless pounding implements *hammer stones*, reserving the name hammer for such as evidently had handles.

Probably the first true hammers were pebbles selected because the forms permitted handles to be lashed to them. The Eskimo hammer (Fig. 2) is an example of such a primitive tool. It consists of a simple wooden handle fastened to a granite pebble by sealskin thongs, but it is, for all its simple construction, a quite efficient and well-balanced striking tool.

Of course, unshaped stones that may once have been made into hammers by ancient man cannot ordinarily be identified, now that time has destroyed the perishable fastenings and handles. There have been found all over the world, however, many stone hammer heads which show unmistakable evidence of having been intentionally shaped by man to turn them into better tools (see Fig. 3). They have a groove about them that made possible a firmer lashing-on of the handle. These grooves were undoubtedly laboriously made by pecking and rubbing with other stones. The handle was usually a flexible withe, bent U-shape around the head and lashed with fiber or thongs. Very rarely a stone hammer has been found with a handle hole through it. Even though many primitive races could drill stone, it seems to have been considered better to put the head through the handle rather than, as we do now, to put the handle through the head.

These stone hammers must have been quite efficient tools, for even after man learned to work metals, he clung to the stone hammer. Not until just before iron came into use do we find bronze hammers, and only a very few of these. The crude implement shown in Figure 4 is from southern Italy and probably dates from 1000 B.C. In many parts of the world where copper and bronze were extensively used, the metal hammer was never developed. It is interesting that the enlightened ancient Egyptians never developed a handled hammer of any kind although they developed the mallet. For all pounding for which a mallet was unsuited, they used a stone held in the hands. The Greeks must have quite generally used the stone hammer, though a few iron ones quite similar to the Italian bronze hammer have been found, but they are all small, hardly more than tack hammers in size.

When we find the hammer among the ancient Romans, we find it for the first time as a tool specialized in form for different purposes. The earlier hammer had been a blow-striking implement that was as much a weapon as a tool. Among its Roman forms we find one with nail-pulling claws. It was of iron, had an oval eye for the handle and was otherwise quite a modern-looking tool. Several have been found on the sites of old Roman army camps and are prized possessions of the museums in which they are guarded. The one shown in Figure 5 is now in the Swiss National Museum. In spite of a missing claw it is undoubtedly a claw hammer. We cannot be sure that this particular hammer is a carpenter's hammer, for farriers also use claw hammers. However, some that have been found are undoubtedly too heavy for horseshoeing purposes, so that we can be reasonably sure that the carpenters of ancient Rome drove and pulled their nails much as we do now.



These old Roman claw hammers had plain shallow handle-eyes not much different from the hammer shown in Figure 6, which is a smith-forged tool of but a generation or two ago. We wonder how a handle in such a shallow eye stood the strain of much nail pulling without breaking. Perhaps, when nails were expensively hand forged, carpenters were careful not to use them so that they had to be pulled frequently. Perhaps another answer is to be found in an old claw hammer from the ruins of Fort Ticonderoga, New York (Fig. 7).

This tool had riveted to the sides of the handle a pair of iron straps that went through the eye as a part of the handle and so strengthened it at its place of greatest strain.

Claw hammers have not always been made with eyes as the means for fastening the handle. The *Encyclopaedia Brittanica* shows a hammer, labeled "Canterbury Hammer" that has side plates betwen which the handle was riveted. These plates are quite like those on the Ticonderoga Hammer except that they were made a part of the head. An early sixteenth-century picture, *Melancholia,* by Albert Dürer, has in it a carpenter's hammer of almost identical form. One of these early eyeless hammers is shown in Figure 8.

Our modern claw hammer (Fig. 9) has a distinct difference from all ancient hammers; it has a deep or adz-type eye that holds the handle so strongly and securely that we seldom think either of a handle breaking or coming loose from the head. This improvement was made about one hundred years ago by David Maydole. His first adz-eye hammers were made in his blacksmith shop at Lebanon, New York, back in the thirties of the last century. So satisfactory did this apparently simple improvement turn out to be, that the village smith who made it was soon head of a great factory which has been making hammers for the world ever since.

Of course, modern hammers are better than ancient ones in other ways than shape. This is especially true of the materials of which the modern tool is made. No one would consider an iron hammer, either cast or wrought, a good one now. We expect a hammer to be of steel especially selected for hammer manufacture, and this steel skillfully hardened so that it will neither yield nor break. We expect a hammer to be beautifully polished and to have that essential quality of suitability to use in the human hand that we call balance. These are the developments of many unlisted research engineers whose combined efforts give the woodworker of today, a tool for one dollar that a vast fortune could not have purchased a hundred years ago.

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Problems and Projects

THE WALKING PIG

W. Harry Phipps, Chancellor Avenue Junior High School, Irvington, New Jersey

This mechanical toy makes a good problem for an elementary woodworking or toymaking class. It involves work with the coping saw and wire bending, along with the stimulating thought exercise of putting the toy together so that it will work. When made and assembled properly it will not only walk when pushed by the handle, but it will wiggle its ears and tail. After being finished, it makes a delightful gift for any small child.

For the wheels, take a compass and draw two 5½-in. circles on a piece of ¼-in. basswood. Saw these out with a coping saw and sand them down. Sand them thinner than the center piece of the body shown in Figure 9. This will permit the wheels to turn inside the pig. Bore a hole just large enough for the heavy wire which is to be used for the axle through the center of each wheel. On one side of the wheel, carve out a cavity large enough to make one complete twisting "kink" of the axle (see Fig. 3). This will make the axle turn as the wheel turns. The axles are shown in Figures 9 and 10. The ends of the axles have to be bent to shape after assembling the wheels and the body. Give the wheels two coats of white enamel. After the wheels are dry, trace on the design of the feet (Fig. 2), and paint them black.

The main body of the pig is made of three pieces of ¼-in. basswood. The two outside pieces are made like Figure 1, and cut out with a coping saw. The holes are bored large enough for the heavy wire used. The inner piece is made like Figure 8, and it does not need to be sanded down, because it must be left thicker than the width of the wheels. The circles cut out for the clearances are 5¾ in. in diameter.

Next, assemble the body, being sure to have the wheels with their axles in place before gluing and bradding the three body pieces together.

The ears and tail are cut from ¼-in. basswood. Two holes are bored in each one for fastening the appendage to the body, and the other is where the wire from the bent axle is fastened in order to make the ears and tail work up and down as the pig walks. The connections are made loose to allow freedom of movement. The wire, being bent square, prevents any chance for connections getting out of place.

The handle is made of heavy wire and a piece of wood, for a "handhold." This handle is about 15 in. long. It is fastened to the pig by bending the ¼-in. prongs at right angles and inserting them into the holes on each side of the back. The top end of the handle is fastened to the wood by bent ends and small staples.

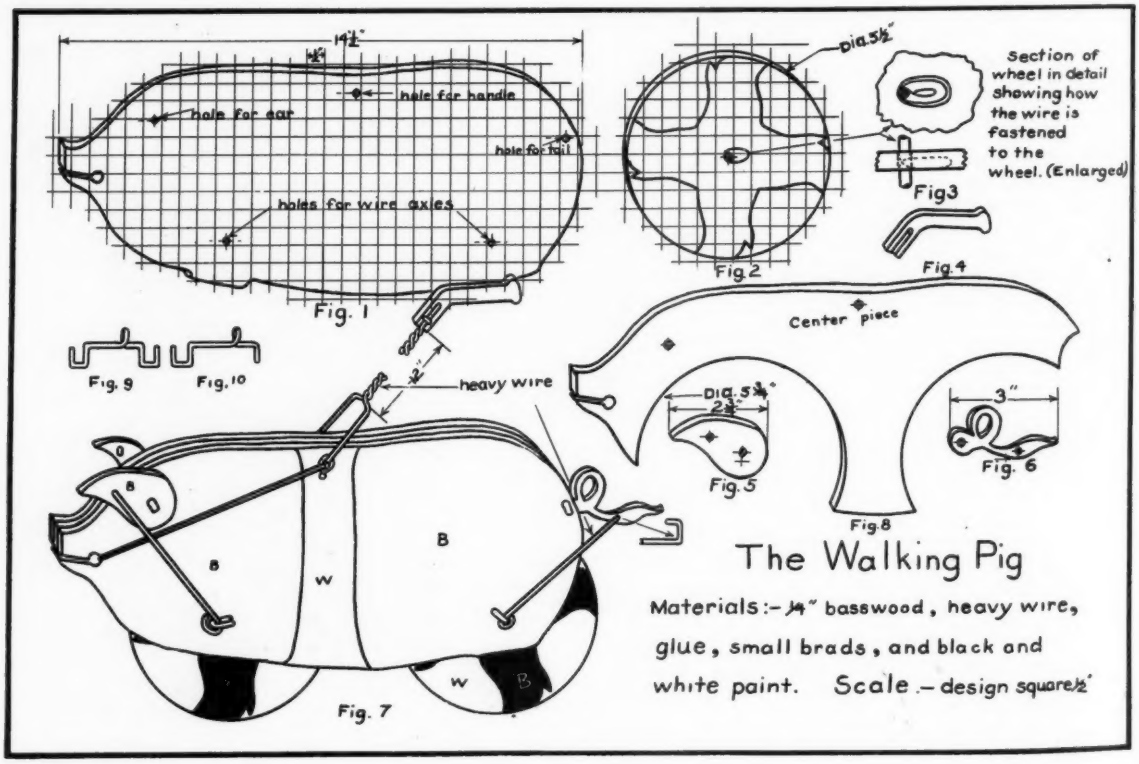
The body is painted black and white, as directed in Figure 7.

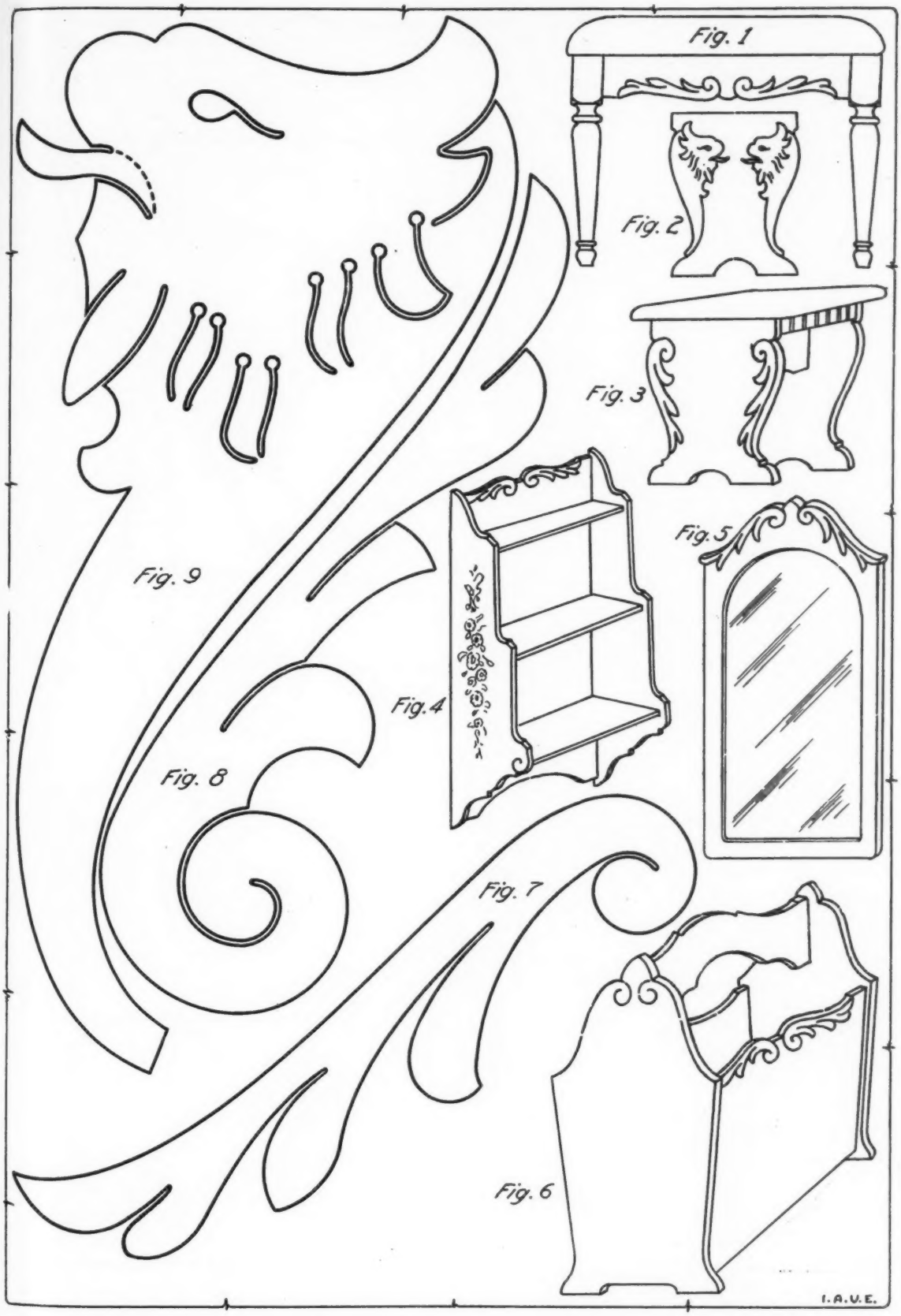
TEMPLATES FOR INCISED CARVING WORK

Joseph J. Lukowitz, Milwaukee, Wisconsin

The beautiful cyma curve which is used so much in furniture design lends itself very well to certain types of enrichment. Frequently this curve is used in the form of the scroll and leaf, or the scroll is used separately. Figures 1, 3, 4, 5, and 6 show projects which make use of enrichment embodying this curve. Figure 2 shows a variation of this curve in the form of a lion's head.

The scroll and leaf are used so much that it is well to make a permanent template of sheet metal. Such a metal





Examples of work with incised ornamentation, also the templates used for laying out the curves

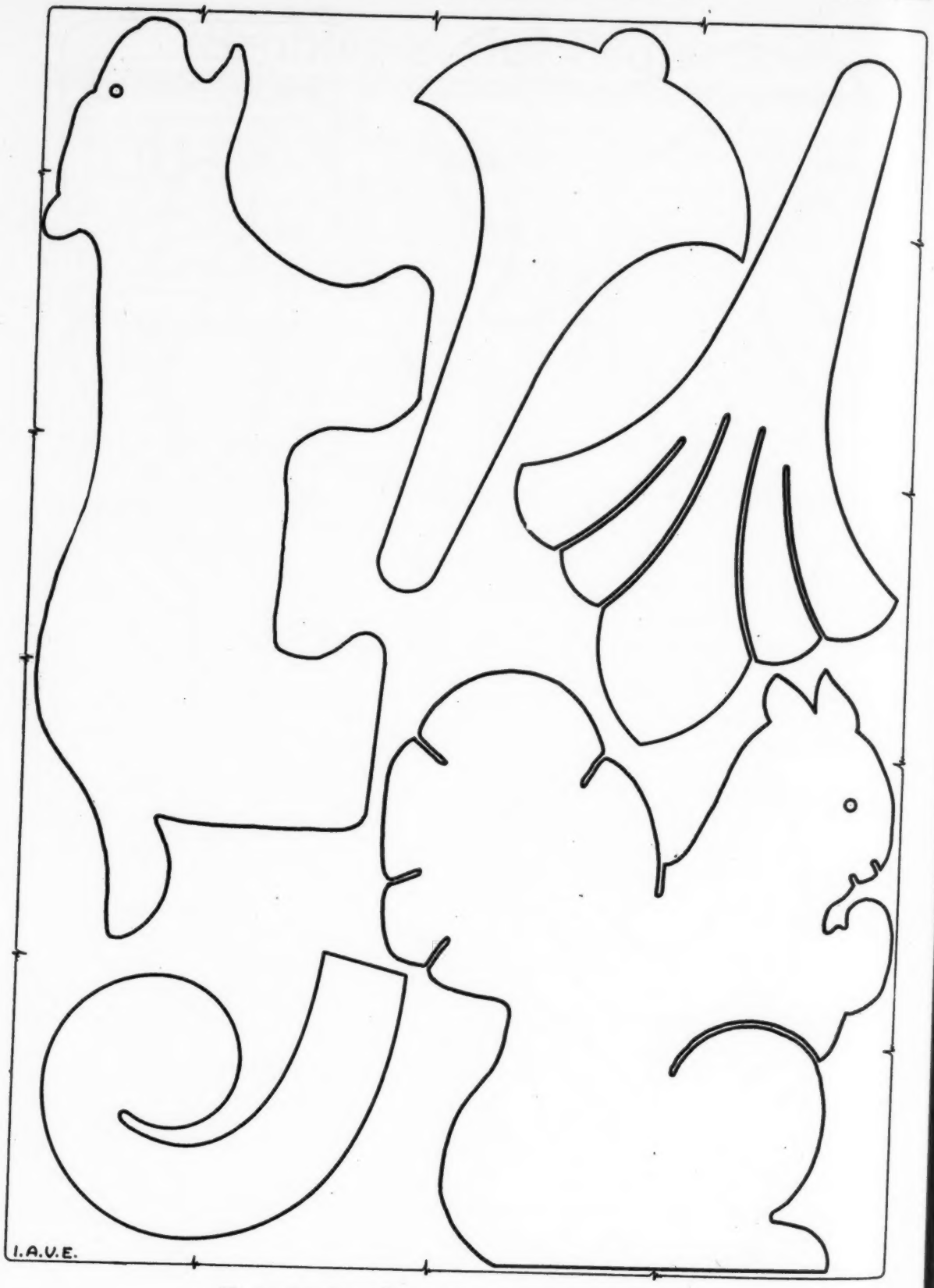


Fig. 12. Examples of other templates for incised carving work

template is practically indestructible, and it retains its original shape and form for an infinite number of tracings. Paper templates are quite unsatisfactory, as they are torn very easily, wear out, and give inaccurate profiles.

Figures 7 and 8 show full-sized patterns for two scrolls, and Figure 9 is a conventionalized lion's head.

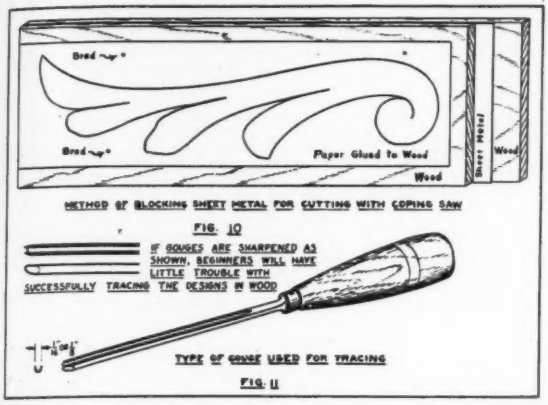

Brad
Brad
Paper Glued to Wood
Wood
Sheet Metal
Wood
METHOD OF BLOCKING SHEET METAL FOR CUTTING WITH COPING SAW
FIG. 10
IF GOUGES ARE SHARPENED AS SHOWN, BEGINNERS WILL HAVE LITTLE TROUBLE WITH SUCCESSFULLY TRACING THE DESIGNS IN WOOD
TYPE OF GOUGE USED FOR TRACING
FIG. 11

Figure 10 shows how the metal is sandwiched between two thin pieces of wood preparatory to being cut with a coping saw. Tin, or copper as light as 12 oz., may be used for these templates. Use a metal-cutting blade for doing the cutting. If any filing is necessary, do the filing before separating the wood and metal.

After the curves have been transferred to the piece to be decorated, almost any boy can creditably outline them with a gouge such as is illustrated in Figure 11. Work which has been enriched with veining of this kind may be finished by staining in the usual manner. The subsequent coats of shellac and wax or varnish will make the design stand out very nicely.

If a contrast or two-tone effect is desired, stain the design first with water stain using a small brush. When this is dry, stain the entire project, including the design, with either water stain, oil stain, or spirit stain, and the design will stand out in a darker shade. If it is desired to have the design lighter than the rest of the project, the design may be shellacked or oiled before the project is stained. This will prevent the stain from penetrating the wood covered by the design and a two-tone effect will be produced.

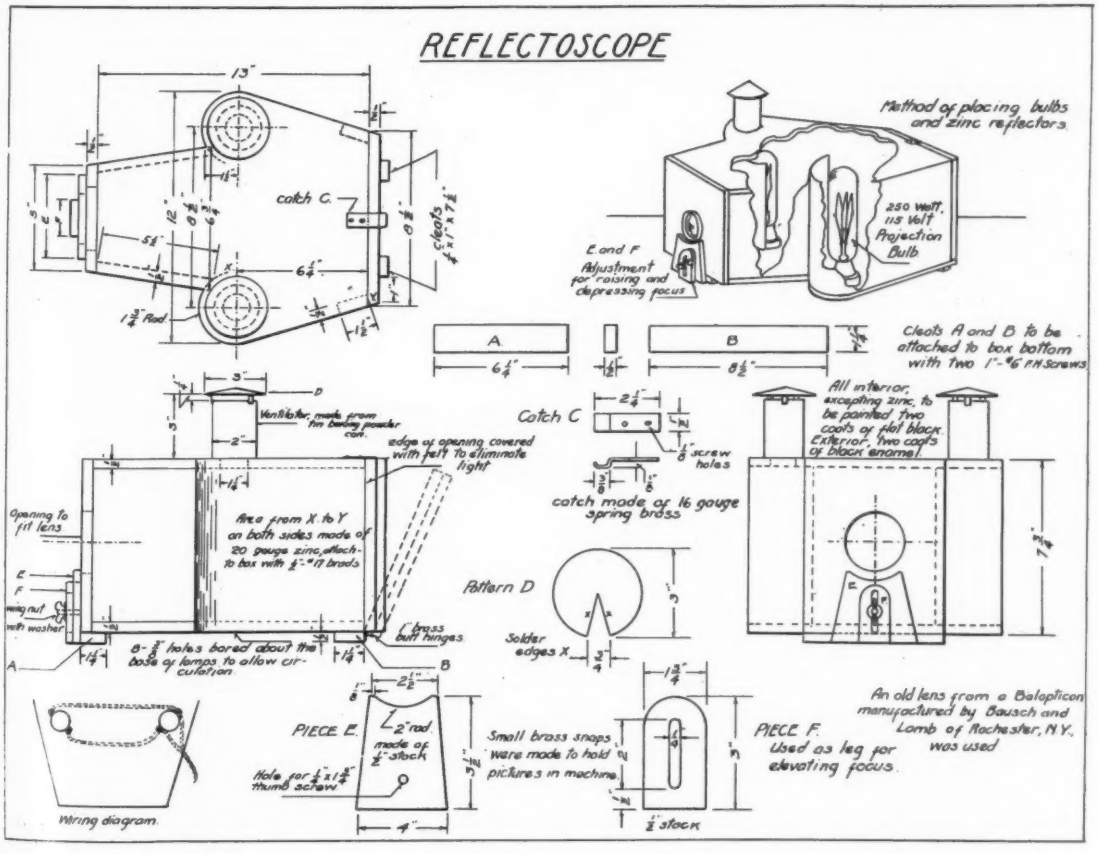
Figure 12 shows several other templates which may be used for this same type of work.

A REFLECTOSCOPE

Leon H. Baxter and Howard Williams, Western Reserve Academy, Hudson, Ohio

It is no longer sufficient to teach scientific subjects from textbooks and laboratory manuals. The student of today must be given practical knowledge of practical things. He must be prepared to do the things that he will have to do, or wish to do, when he becomes an active rather than an associate member of society. He must go further than to draw a diagram of how a doorbell should be wired. He must be working with interesting material, practical material, and he must be working with his hands. The industrial-arts shop has long recognized these principles, and is therefore in a position to cooperate with the science department in its effort to make science more useful and less scholastic.

There are several reasons why hand work in the science department is valuable. First, there is the interest factor, and then there is the economy angle to be considered. An instance in point is the making of a reflectoscope for the projection of


REFLECTOSCOPE
13"
catch C.
cleats
1¾" Rod
Method of placing bulbs and zinc reflectors
250 Watt, 115 Volt Projection Bulb
E and F Adjustment for raising and depressing focus
A
B
Cleats A and B to be attached to box bottom with two 1"-6 F.H. Screws
Ventilator, made from tin baking powder can
edge of opening covered with felt to eliminate light
Catch C
screw holes
catch made of 16 gauge spring brass
All interior, excepting zinc, to be painted two coats of flat black. Exterior, two coats of black enamel
Opening to fit lens
Area from X to Y on both sides made of 20 gauge zinc, attached to box with ½" #7 brads
Pattern D
brass butt hinges
Solder edges X
8-⅜" holes bored about the base of lamps to allow circulation
PIECE E.
2" rad. made of ½" stock
hole for ¼"x1½" thumb screw
Small brass snaps were made to hold pictures in machine
PIECE F.
Used as leg for elevating focus
An old lens from a Balopticon manufactured by Bausch and Lomb of Rochester, N.Y., was used
Wiring diagram
½" stock

opaque objects which two boys made in the industrial-arts shop of our school for the use of the science department.

A new piece of laboratory apparatus usually arouses interest. When the newness has worn off, however, the interest disappears rapidly. Not so with the homemade apparatus. The reflectoscope mentioned above was six weeks in the making. Needless to say, interest did not lag during its construction. It has been the subject of one speech before the assembled school, in which the projector itself was used to throw diagrams of its construction before the assembly and thus tell in part of its own story. Its interest in this way became school-wide. It has been the subject of a very well written story of its construction which has been given special credit in English composition. All in all, it has been pretty much before the school public for the greater part of the year. One could hardly imagine a purchased reflectoscope causing such interest as this.

Compare the educational value of the purchased and the homemade scientific apparatus. In order to build the reflectoscope already referred to, the boys had to look up the construction of lenses such as they would need for the particular job they were trying to do. They had to find the focal length of the lens after it had been obtained. They had to know the laws of reflection of light in order to properly place the reflectors in the reflectoscope. They had to learn about the absorption of light by dark colors so as to know how to treat the inside of the reflectoscope to make it throw a picture as clear-cut and as distinct as possible. They had to learn how to plan ahead on a job so as to be able to successfully complete their task. They had to learn how to joint and fit the parts together, how to solder, how to paint and finish the job, how to install and wire the electric parts, and many other things.

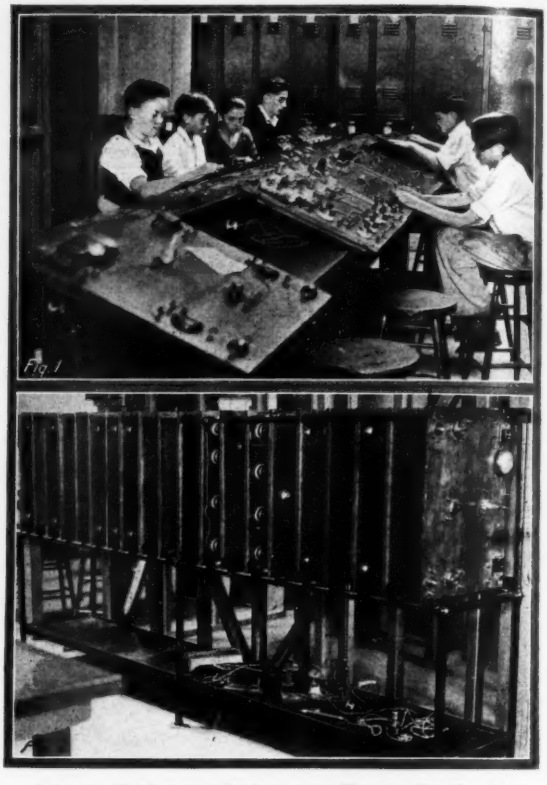


Fig. 1. Wiring panels in use — Fig. 2. Panel rack

WIRING PANEL RACK

Harrie D. Chapel, Long Beach, California

Wiring panels used as shown in Figure 1, offer a quick and efficient method of teaching circuit connections in a shop where time and space are limited.

When not in use, these panels may be stored in the rack shown in Figures 2 and 3. This leaves the tables free for other purposes.

The panels are regular 20 by 26-in. drawing boards. Some are kept free of apparatus to be used as drawing boards, while others have bells, buzzers, push buttons, sockets, switches, and so forth, mounted permanently upon them with the terminals brought out to thumb screws for convenient connections.

The mains for storage battery, transformer, and 110-volt circuits are run in the box down the center of the table with outlets brought out on both sides so that each student may make use of any one of them without interfering with the other students. The 110-volt supply is so arranged that either d. c. or a. c. current may be used.

The panels are secured to the table by means of hooks, similar to screen hooks, made of ½-in. strap iron. Each panel is supported on the rack by a piece of heavy sheet iron turned up ½ in. on each side of the panel, and held in an upright position by two short pieces of ¾-in. strap iron at the top of each panel.

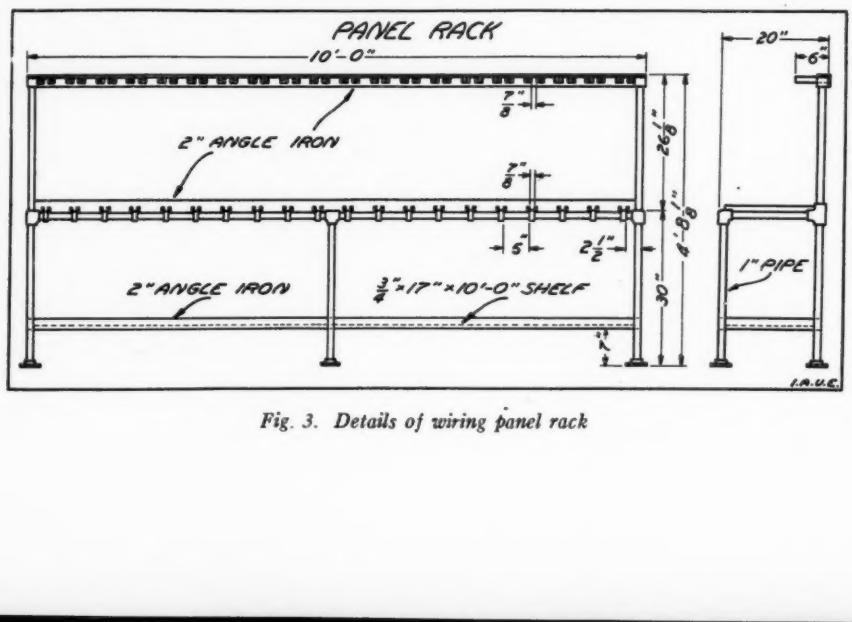


Fig. 3. Details of wiring panel rack

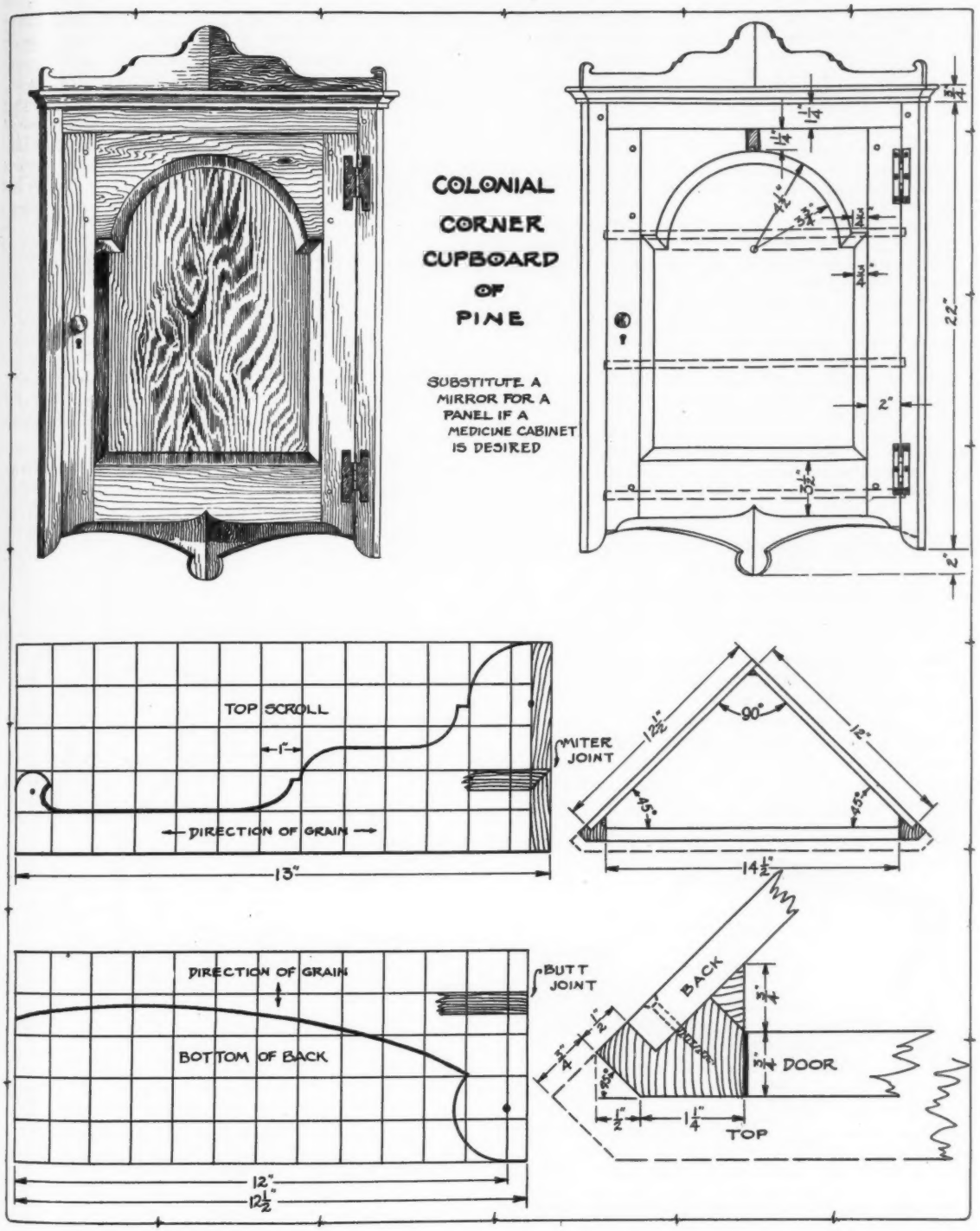
COLONIAL CORNER CUPBOARD OF PINE

Ken F. Shepardson, La Crosse, Wisconsin

Colonial corner cupboards are popular as they are both decorative and useful. They gracefully fill in an otherwise bare corner and do it without obtruding. A medicine cabinet of this type fits in nicely with a corner lavatory.

To be a true reproduction, the corner cabinet should be made of pine of pleasing grain. Solid knots, if not too large, are desirable. The grain of the door panel should be properly balanced and much bolder than the rest. A dark-brown stain with a dull-rubbed varnish, lacquer, or shellac finish should be applied unless the cabinet is to be used in a bathroom. In the latter case the finish may be a colored lacquer or enamel with a mirror in place of the panel.

The top provides a space for a small clock or some decorative piece. A miniature bust of Washington or some other colonial figure may be used.



It is desirable to have the prospective builder lay out a full-sized plan of the problem on paper. An interesting study in angles will be encountered and the drawing will result in a better understanding of the parts before construction begins. Also the exact size and shape of the three shelves can be determined, and the drawing will serve as a pattern for them. The drawing will impress the builder with the necessity of accuracy in making the two uprights.

The two back pieces, three shelves, top rail, and two uprights should be shaped and smoothed, and then assembled in the following manner:

1. Space shelves and mark their location on both sides of the back pieces. Marks on the inside will show where the shelves fit. Marks on the back side will show where to nail.
2. Fasten back pieces together by the use of a butt joint and screws.
3. Nail top and middle shelf in place.
4. Fasten bottom shelf in place with screws as this shelf will have to keep the bottom part of the cabinet together.
5. Fasten uprights to back pieces with screws as shown in drawing (corner detail).
6. Fit top rail into place. Mortises in top of uprights are open. Tenons need not be glued.

7. Clamp these joints together and drill holes for dowels. Glue dowels leaving about ⅛ in. of dowel protruding on outside.

The three-sided corner fillers are next tacked into place.

The top projects ¾ in. on the front. If edge shown in the drawing cannot be made in the shop, some simpler edge may be used. A ¼-in. chamfer may be used underneath the top if nothing else. The top is fastened with flat-head screws and those in the front rail may be covered with plugs or dowels smoothed flush.

The back scrolls are mitered at the corner and are fastened to the top with flat-head screws also covered with plugs or dowels smoothed flush.

The door panel should be made of ½-in. solid pine and the grooves in the frame should be ¼ in. wide by ¼ in. deep and in the center of the frame. Therefore, the radius for the outside half circle of the panel will be ¼ in. more than the radius for the half circle in the top rail. The sides and bottom of the panel may be sawed by tilting the fence, but the bevel on the curved top must be carefully worked down by hand. The groove or dado in the top rail can be made with a ¼-in. chisel.

The mortise-and-tenon joints in the doorframe are locked with dowels glued into place. These dowels are rounded off like a button, as there is no pretense of hiding them.

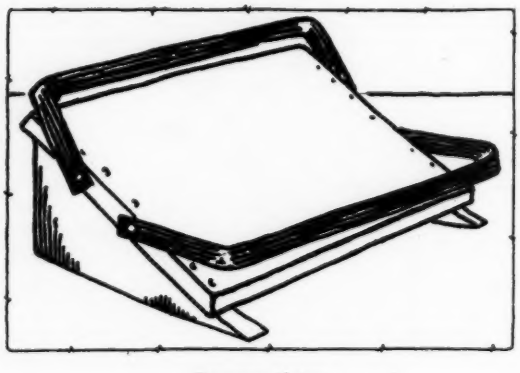
A wooden knob should be turned, and a cartridge or button catch used for the door. A lock may be added without an escutcheon. Copper or bronze hinges of the type shown are preferred, but plain butt hinges are better than surface hinges which do not harmonize.

A TEACHING AID FOR THE PRINTSHOP TEACHER

Hugh Flaherty, Sewanhaka High School, Flora Park, New York

The device described in this article will be found very helpful in teaching boys how to change a tympan. In the ordinary school printshop, there are but few presses, and these are usually occupied with work that must be out on time. Hence it is difficult to give the pupils practice in the necessary operation of changing a tympan.

In order to overcome this, the author had dummy platens constructed for each student in the class. These platens were then used much the same way that dummy keyboards are used in the linotype schools.



Dummy platen

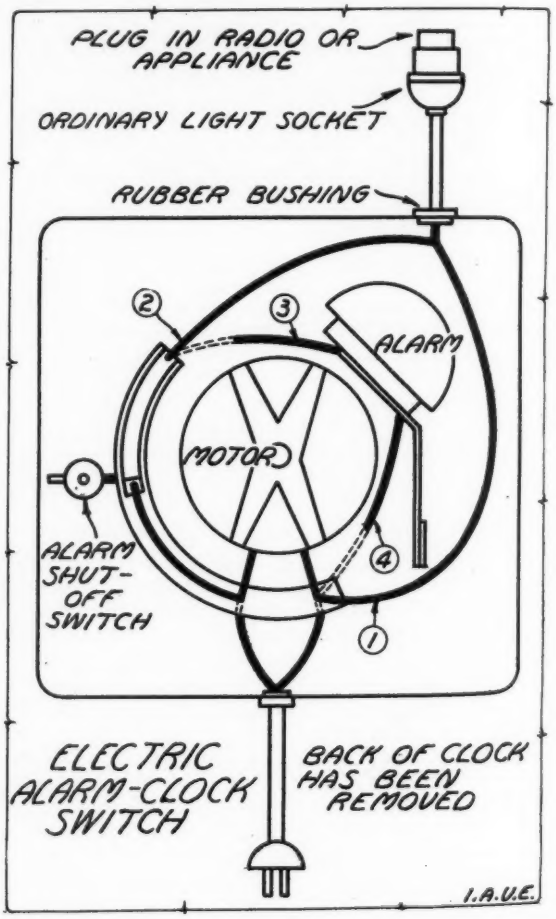
They were constructed of wood with two iron bales, and were made about the size of the platen on an 8 by 10-in. press. The one illustrated is 10 by 14 in. over all. It is made of ⅞-in. pine boards. The bales are made of ½ by ⅛-in. strap iron held in place by round-head wood screws. The platens are mounted at an angle of 45 degrees, and the triangular end pieces are made to extend beyond the face so that the bales will not swing under when the tympan is clamped in place.

To use these dummy platens, give a class demonstration showing the correct method of putting on a tympan and setting the guides. This may be done on the regular press. Explain carefully the relationship of the dummy platen to the real platen. Then have each boy put a tympan on the dummy platen, furnishing him with a pressboard, sized and supercalendered paper, and a top sheet. Then inspect each tympan carefully, because even so simple an operation as putting on a tympan has many pitfalls for the inexperienced. After the tympan has been put on satisfactorily, stamp an impression of a job, using either a rubber stamp or an old zinc cut, on the top sheet. Give the pupil paper cut to size for this job and let him proceed to set the guides, using quads. There is a lot to learn about setting guides and a boy can make a great many mistakes.

ELECTRIC ALARM CLOCK AS AN AUTOMATIC SWITCH

O. C. Nelson, Madison, Wisconsin

An electric alarm clock ($1.25 variety) can be used to turn on a radio or any appliance at a specified time, if a few internal changes are made. After the alterations shown in the accompanying diagram have been made, the clock may be "set" in the usual manner to turn on the appliance instead of the alarm.



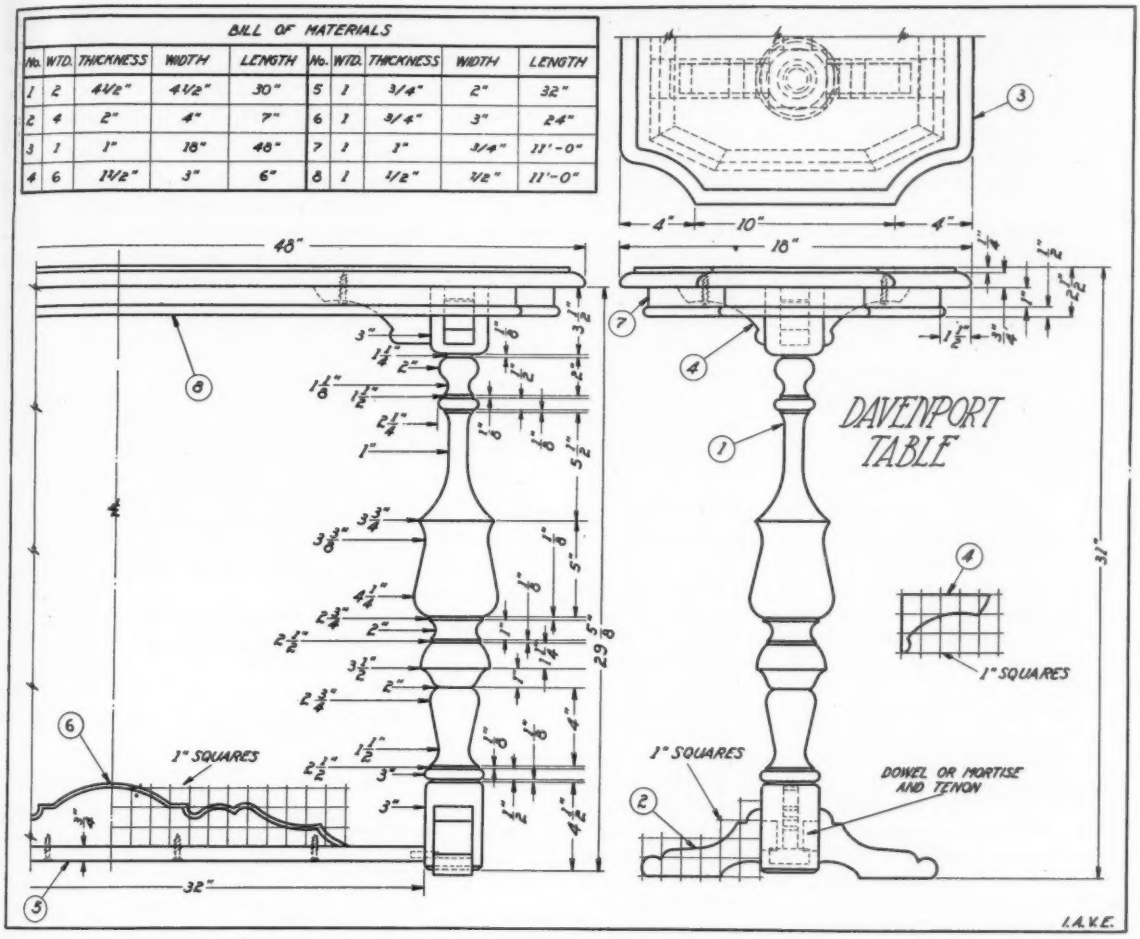
This arrangement has been tested on appliances drawing heavy currents and is entirely satisfactory. It will operate the appliance for approximately 45 minutes (varies with the design of the clock) before resetting is necessary.

The steps necessary to make the required alterations are as follows (numbers refer to those on accompanying sketch):

a) Remove back of the electric clock.

b) Disconnect both wires Nos. 3 and 4 from the alarm.

c) Find or make a hole in back or side of the clock for the lamp cord to enter.


BILL OF MATERIALS
No. WTD. THICKNESS WIDTH LENGTH
1 2 4½" 4½" 30"
2 4 2" 4" 7"
3 1 1" 18" 48"
4 6 1½" 3" 6"
5 1 ¾" 2" 32"
6 1 ¾" 3" 24"
7 1 1" ¾" 11'-0"
8 1 ½" ½" 11'-0"
DAVENPORT TABLE
1" SQUARES
DOWEL OR MORTISE AND TENON
I.A.V.E.

Davenport table designed by Floyd D. King, Phoenix, Ariz.

d) Solder one wire from this cord to No. 1.

e) Solder other wire from cord to No. 2.

f) Replace the clock back.

g) Attach socket to opposite end of cord; then plug in appliance.

h) Set clock as usual. The *off* and *on* switch will work as usual.

This makes an interesting problem for a boy in the junior-high electric shop. There is room for a wealth of related information to be brought in with this as a project, as well as plenty of motivation.

OPERATION SHEETS FOR MACHINE WOODWORK

V. E. Broadbent, Santa Clara, California

Ripping on the Universal Saw Table

Tools

Double-arbor universal saw table, try-square, scale.

Directions

1. Turn the saw-shifting wheel until the ripsaw barely projects above the wood to be ripped.

2. Place the ripping fence on the right-hand side of the table and fasten it with the stop pins in the set of holes best suited for the board.

3. Look at the quadrant of the back of the saw to see if the table is tilted. Adjust, if necessary.

4. Test the fence with a try-square to see if it is square with the table. Adjust, if necessary, by means of bottom setscrew and the upper screws.

5. Lock the sliding table by means of the screw provided.

6. Loosen the fence-lever screw and by means of a scale set the fence the required distance from the inside (right-hand side) of the saw teeth. For rough work the scale engraved on the table may be used.

7. Tighten the fence lever.

8. Put the saw guard in place. *Never rip without it.*

9. Start the machine and listen for any strange noises. See if the saw wabbles. Report trouble at once.

10. Stand close to the table and far enough to the left to avoid being hit if the wood is thrown back.

11. If the wood is at least 6 in. wide, hold it down and push it through with the right hand close to the ripping fence. Use the left hand to help hold the stock against the fence and down, allowing the wood to slide against the left-hand fingers without moving the hand forward. *Never straddle the saw* with a hand pushed past it on each side.

12. For stock 2 to 6 in. wide, push the wood through with a stick notched to fit over the rear end. Steady the wood with the left hand as before.

13. For stock less than 2 in. in width, push the board halfway through and then reverse the wood and rip the remaining half. This is a good method for all narrow stock and for short lengths.

14. For long boards, have a helper pull the work through after it has passed the rear table, while you hold it down and against the fence.

15. Push the wood through as fast as it will go without slowing up the saw.

16. Go slowly with hard wood and get permission before sawing hard wood thicker than 2 in. Stop the saw immediately if it shows signs of wabbling.

17. Be very careful of loose neckties, sleeves, etc.

Questions

1. Why would being caught by the back teeth be more damaging than by the front teeth?
2. What edge of the wood should be held against the fence?
3. How can the circular ripsaw be distinguished from the crosscut saw?
4. What is the object of the splitter attached behind the saw?
5. Should the ripping fence ever be moved while the saw is going?
6. How would you prevent the ripping fence from being damaged by very narrow ripping?

References

Hunt's *Manual for Machine Woodworking*, pp. 17–25.
Griffith's *Woodwork for Secondary Schools*, pp. 94–98.

MODEL LIFTING MAGNETS

Lee M. Klinefelter, Ruffner Junior High School, Norfolk, Virginia

Model lifting magnets are interesting and instructive problems for students of the general or the electrical shop, in either the junior or senior high school. They give an opportunity for an effective demonstration of the laws of electricity and magnetism, of the use of magnets in industry. They also present opportunities for some interesting and instructive electrical calculations.

The magnets described here have been designed for low-voltage operation, either on a 6-volt storage battery or on one or more dry cells. This is because lifting magnets do not operate well on alternating current, and direct-current voltage higher than six volts is not usually available in school shops. Another advantage is that when these magnets are wound for lower voltage, the wire size is larger, and the cost lower.

Two general methods of construction are shown in Figures 1 and 2. Figure 1 illustrates a magnet having a cast-iron or steel core. It involves patternmaking, the casting of the core, machining the core, cutting the brass or copper ring that holds the winding in place, making the central steel plate to hold the ring in place, as well as drilling and tapping. The coil is form-wound on a wooden form, taped, and slipped into

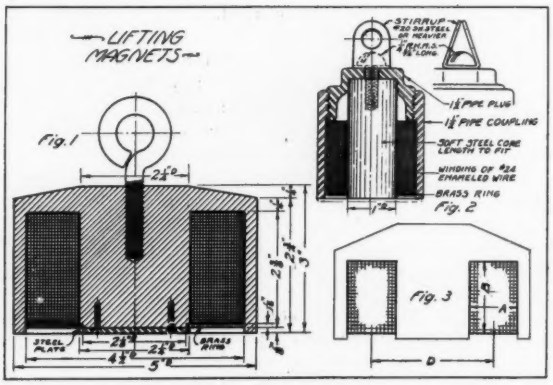


Fig. 1. Section of lifting magnet with cast-iron core. Fig. 2. Lifting magnet made from 1½-in. pipe fittings. Fig. 3. Magnet winding space.

place, the leads coming out through a hole or holes in the top. If made to the dimensions of the drawing, it should be wound with No. 14 enameled wire. Seven or eight pounds will be needed.

The second type of magnet is considerably simpler to make, but is just as effective in proportion to size. It calls for a wrought-iron or steel pipe plug and coupling of almost any size. The one shown in the drawing is 1½-in. pipe size, but we have built them as small as ½-in. pipe size and as large as 2½-in. with satisfactory results. The smaller ones may be used with erector sets.

As shown in Figure 2, the threads of the coupling are cut out on the lathe with the exception of the few threads needed to hold the plug. If the plug is very thick it may be faced off to make more winding space. The core is a piece of soft-steel or wrought-iron shafting having a cross section approximately equal to that of the shell. In the 1½-in. size, the core should be about an inch in diameter. The core is turned down at the inner end to fit snugly into the plug, or in some cases it may be better to turn out a socket in the plug to take the core. The core is held in place by a bolt or machine screw which also holds a stirrup for mounting the magnet.

The coil is wound directly on the core over paper insulation and is held in place by two fiber or cardboard washers. For the 1½-in. size, No. 24 enameled wire gives good results. Enameled wire is used to give maximum ampere-turns in the limited winding space. Since the magnets are operated on direct current, short-circuited turns are not so serious as in alternating-current devices.

The calculation of the best wire size for magnets can be simplified so as to come within the understanding of at least some ninth- or tenth-grade boys. The accompanying condensed table contains the necessary data for the more commonly used sizes. For the sake of simplicity these data are given for enameled wire only.

Since the strength of the magnet increases with the ampere-turns, thought not in direct proportion, the problem in a magnet of this kind is to get the greatest possible ampere-turns without increasing the current density to the

MAGNET WINDING DATA FOR ENAMELED WIRE

Wire Size	Circular Mills	Turns per Square Inch	Ohms per Cubic Inch
10	10,380	91	.0076
11	8,234	112	.0118
12	6,530	142	.0187
13	5,178	172	.0288
14	4,107	222	.0468
15	3,257	278	.0737
16	2,583	357	.1260
17	2,048	432	.1820
18	1,624	536	.2890
19	1,288	698	.4690
20	1,022	865	.7320
21	810	1075	1.1500
22	642	1365	1.8400
23	509	1690	2.8700
24	404	2140	4.5800
25	320	2680	7.2300
26	254	3420	11.6000
27	201	4225	18.1000
28	160	5390	29.2000
29	128	6680	45.1000
30	100	8520	73.3000

Table I. Magnet-winding data

point where heating becomes dangerous. If the magnets are to be used only for short periods, the circular mill allowance can be safely reduced to 750 or less. For continuous operation it should be 1,000 circular mills per ampere or more.

Another limiting factor may be current capacity of the battery which is to be used. The large magnet draws considerable current when wound with the larger sizes of wire.

The first step in the calculations consists of determining the winding cross section, the average length of turn, and the volume of winding. Figure 3 shows the measurements needed

for finding these values. The winding cross section is found by multiplying A times B, or $S = A \times B$.

The average length of turn is equal to the average diameter times π (3.1416), or $L = 3.14 \times D$.

The volume of winding equals the cross section times average length, or $V = S \times L$.

Table I gives the circular mill area, turns per square inch of solid-layer winding, and resistance per cubic inch of solid-layer winding for enameled wire.

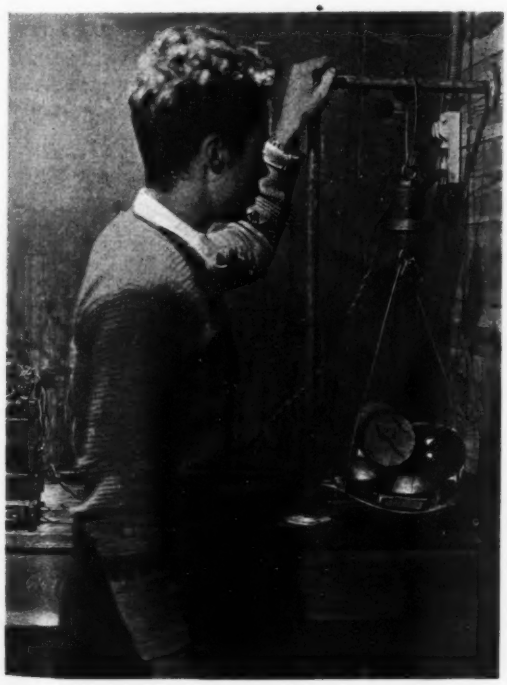
Table II is used for making calculations for the magnet that is to be designed. When designing a new magnet, rule a paper with columns similar to Table II and fill them in the order given with the calculations. The winding cross section is first calculated as described. Total turns (T) is found by multiplying S by turns per square inch from column 3 in Table I. To start off, it will be necessary to assume some wire size as a starting point, and then work up or down from this, if it is found to be too small or too large.

MAGNET CALCULATIONS

Magnet	Wire Size	Winding Section	Total Turns	Winding Volume	Total Resistance	Current	Current Density	Ampere Turns	Watts Input
Fig. 1 on 6 volts	12	2½	320	23.6	.45	13.3	480	4250	80.00
	13	2½	388	23.6	.69	8.7	600	3370	52.00
	14	2½	500	23.6	1.11	5.4	760	2700	32.00
	15	2½	625	23.6	1.75	3.4	960	2120	20.00
	16	2½	800	23.6	3.00	2.0	1290	1600	12.00
Fig. 1 on 110 volts	27	2½	9500	23.6	430.00	.24	840	2280	26.00
	28	2½	12100	23.6	700.00	.16	1000	1940	18.00
Fig. 2 on 1½ volts	19	.52	365	2.25	1.05	1.43	900	520	2.15
Fig. 2 on 6 volts	22	.52	710	2.25	4.15	1.45	445	1030	8.70
	23	.52	880	2.25	6.45	.93	550	815	5.60
	24	.52	1110	2.25	10.30	.58	700	645	3.50
	25	.52	1400	2.25	16.30	.37	865	520	2.20
	26	.52	1775	2.25	26.00	.23	1100	410	1.40

Table II. Magnet calculations

Winding volume (V) has already been found from Figure 3, and total resistance (R) equals V multiplied by the resistance per cubic inch from column 4 in Table I. The current (I) can now be found by dividing the applied voltage (E) by the total resistance (R). Dividing the circular mill area of the wire from column 2, Table I, by the current (I) gives the current density (D) which, as already mentioned, should be in the neighborhood of 750 for intermittent use, and 1,000 or more for continuous use.



Lifting magnet made from 1½-in. pipe fittings supporting load of 65 pounds

The ampere-turns, found by multiplying T by I, gives a rough means of comparing the pull of the magnet when wound with different sizes of wire. The last column, watts input, found by multiplying E by I, indicates the amount of energy used and the heat that must be dissipated.

From Table II, it will be seen that there is a choice between several wire sizes for any magnet. If maximum strength is wanted for short periods, No. 12 or No. 13 might be used for the large magnet, but may have to be ruled out on account of the amount of current consumed. With a current of 5.4 amperes and a density of 760 circular mills per ampere, No. 14 wire is a good compromise for short periods of operation, while No. 15 or No. 16 are more conservative and use less current, but give considerably less pull as indicated by the ampere-turns.

This magnet could be wound for 110 volts by using No. 25 or 26 wire as next shown in Table II, but, of course, at somewhat greater cost for the smaller wire.

Calculations for the small magnet are given next, the first two being for operation on a single dry cell. The battery capacity will probably be the limiting factor in this case. When operated on a 6-volt battery, this magnet should be wound with from No. 22 to 26 wire, depending on the periods of time for which it is to be operated.

The magnet shown in the photo supporting a weight of 65 pounds of lead and steel, was built with 1½-in. fittings and wound with No. 22 wire for operation on a 6-volt battery.

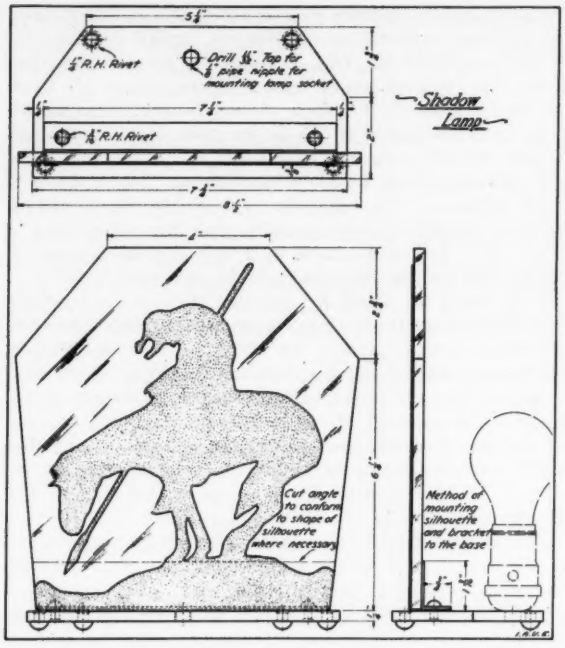
SHADOW LAMP

L. E. Burba, Gratis High School, Gratis, Ohio

The shadow lamp described herewith will help to stimulate the student's imagination and creative skill. Many variations may be worked out for this type of lamp. This particular design was used because it is easy to draw and construct.

Shadow lamp

The base is made of scrap angle iron. It may be obtained from bridge works, boiler factories, and quite often from junk yards. It should be of sufficient thickness and width to over-


Drill ⅝" Top for ¾ pipe nipple for mounting lamp socket
¼" R.H. Rivet
¼" R.H. Rivet
Shadow Lamp
Cut angle to conform to shape of silhouette where necessary
Method of mounting silhouette and bracket to the base

balance the weight of the glass. Hammering and filing the base adds to the beauty of it. The ¼-in. r. h. rivets used in the base must be riveted to the base before attaching the silhouette. The holes should be countersunk. The hole for mounting the lamp socket must be drilled and tapped.

The silhouette and bracket are made of 18 or 20-gauge black iron. A jig saw with a coping-saw blade for cutting metal has been found to be a speedy method of cutting out the silhouette. The cutting also may be done with a metal-cutting blade in a coping-saw frame. The bracket runs the full length of the silhouette, its top edge conforming with the contour of the edge at the feet of the horse. Three-sixteenths-inch roundhead rivets are used for mounting.

The glass is ordinary windshield glass. Scraps of sufficient size may be found usually around any garage. For this particular design the glass is 9 in. long, 8½ in. at the widest part, and 7¼ in. at the base. After the glass has been cut to the given dimensions, the edges are smoothed on a grindstone. The side next the lamp is frosted.

The silhouette suggests a glass of curved outline. For the junior-high-school boy this has been found to be rather difficult to cut and tends to discourage the individual.

CLOCK MOTOR POWER PLANTS FOR TOY BOATS

R. W. Wagner, St. Paul, Minnesota

In Figure 3 of the accompanying halftone, is shown the sheet-metal toy boat described on page 227 of the July, 1932, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION. The motor installed in it is an old spring motor salvaged from a discarded toy locomotive.

Alarm-clock works may also be used as power plants. Figure 1 shows two types. There are two separate trains of wheels in each, one for the time and one for the alarm. The time side has the more powerful motor and is the one used for the motor boat. Cut away the part of the frame that is not needed in order to make the motor as light as possible. Figure 2 shows the parts of a clockwork that are useful when used as a motor. At A, in this figure, are wheels, at B are solid pinions, at C wheel-pinion units, at D is the first wheel or great wheel which carries the mainspring, and at E is shown the second wheel which carries the minute hand in one-day clocks.

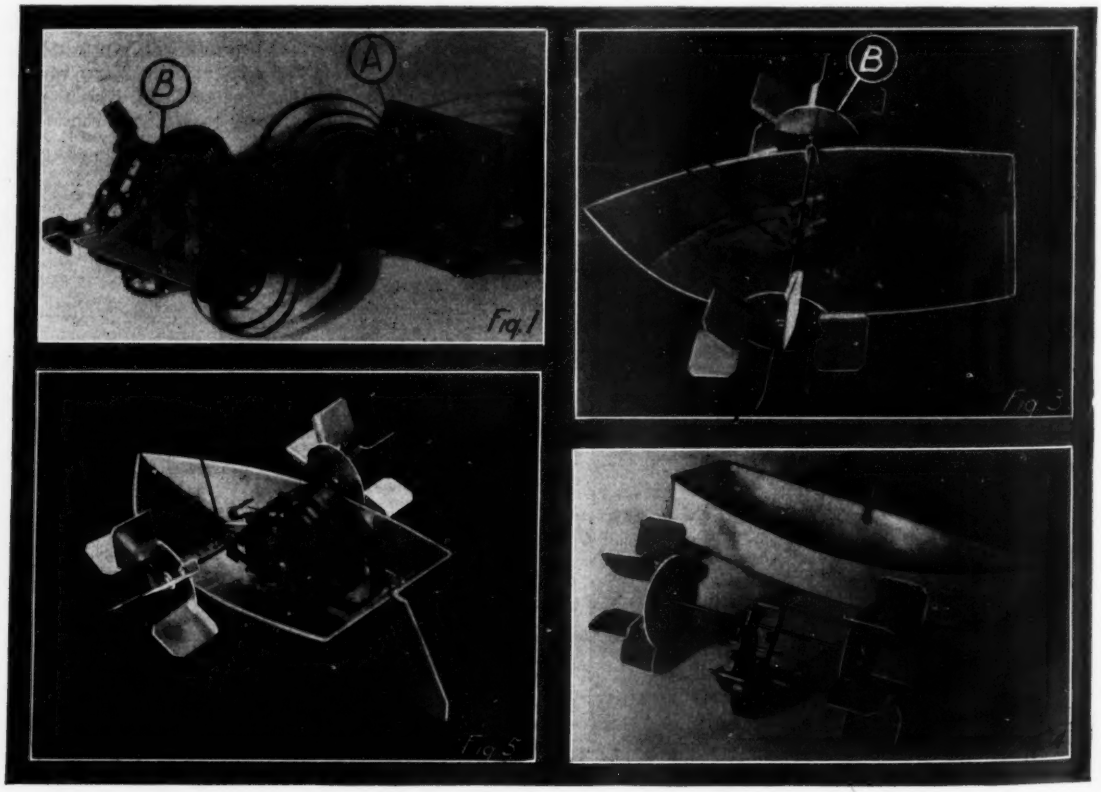


Fig. 1. Two typical movements from one-day alarm clocks. Fig. 3. How the power plant is installed. Fig. 4. A light-weight motor with paddle wheels attached. Fig. 5. How the rudder is attached.

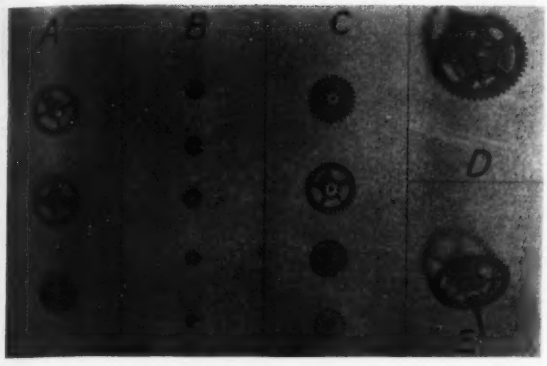


Fig. 2. Clock movement parts

For the boat motor, power is taken off the third shaft, or third wheel, the paddle wheels being mounted on it (see Figs. 3 and 4). This third shaft, or wheel, is not used as it is found in the movement. It is made from a piece of wire and the pinion is soldered to it. The finding of this pinion is something of a problem. Sometimes it may be found on the movement used for the motor, but occasionally it must be taken from another.

There are two places on a movement to look for it. One is at A, Figure 1. This is a wheel-pinion unit used in the reduction gear for the hour hand. It is mounted on the outside of the frame and is easily removed. Another thing that makes it desirable is the fact that it is very long. But if its teeth do not mesh with the teeth of the second wheel it cannot be used. Another possible source is shown at B, Figure 1. This pinion is forced on the minute-hand shaft and if used, must be driven off. This must be done very carefully or the pinion will be damaged. A pinion must be found with teeth that will mesh with the teeth of the second wheel.

The problem of using a clock movement for the side-wheel boat resolves itself into the following steps:

Knowing where to take off power.

Cutting away parts of the frame not needed.

Finding a pinion to fit the second wheel.

Finding a shaft to fit the hole in this pinion.

Mounting this shaft in two bearings attached to frame.

Holding the shaft in place with two collars.

Disassembling and Cutting Down

Take the movement out of the case and look it over, noticing which wheels are in the time train and which are in the alarm train. Decide which strip of frame is to be left in for the purpose of mounting the bearings (see Figs. 3 and 4). With a scratch awl, mark where the frame is to be cut, putting the marks on both sides of the frame. Remove the reduction gear wheels on the outside of the frame. Take the movement apart by removing the side of the frame that is held in place by the hexnuts. Cut away the parts of the frame not needed. This may be done with tin snips, or with a coping saw fitted with a special metal-cutting blade. True up the frame if it was bent in cutting, and file off sharp corners.

Making Extra Parts

Get the solid pinion that is to go on the drive shaft. If it is of a wheel-pinion unit, cut away the wheel part. Cut a piece of wire about 7 in. long and of a diameter to fit the hole in the pinion. Straighten this wire carefully with a hammer. Tin the end of the pinion where the wheel was, and the spot on the shaft where the pinion is to be mounted. Then sweat the pinion in place on the shaft. Use great care in doing this or the solder will be drawn up between the teeth of the pinion and the job ruined. Hold the shaft horizontal while sweating on the pinion.

Make two bearings (A, Fig. 3) from pieces of the discarded frame. Drill a hole near the end of each piece that will fit the shaft loosely. Sometimes these holes can be found already in the frame so it will not be necessary to drill them. The length of the bearings must be enough to allow them to fit neatly on the part of the frame that was left for mounting them.

Assembling

Put the great wheel and the second wheel in place in the frame and clamp the loose side of the frame in place with the hexnuts. See that the wheels run freely. Slip the bearings on the shaft. Clamp the bearings to the frame with two small C clamps. Adjust the shaft and bearings until the shaft is parallel with the other shafts and until the pinion meshes easily with the second wheel. Tighten up the clamps and attach the bearings to the frame with a few drops of solder. Great care must be used here also or the shaft will be sweat to the bearings. Test the motor to see that there is no binding or extra friction. Select two hexnuts to be used for collars (A, Fig. 5). Slip the hexnuts in place on the shaft and adjust the shaft until the second wheel comes in the middle of the pinion. Then very carefully sweat the nuts to the shaft. The greatest of care must be used here or the nuts and shaft will be sweat to the bearings.

NO.	MATERIAL	SIZE	REQ.
1	ANGLE IRON	2"×2"×1/8"×3"-6"	4
2	ANGLE IRON	2"×2"×1/8"×26 1/16"	4
3	ANGLE IRON	2"×2"×1/8"×17 3/4"	4
4	FLAT IRON	2"×1/8"×26 1/4"	2
5	FLAT IRON	2"×1/8"×17 3/8"	2
6	FLAT IRON	2"×1/4"×3 1/2"	2
7	ANGLE IRON	2"×2"×1/8"×19"	1
8	ANGLE IRON	2"×1"×1/8"×14"	2
9	FLAT IRON	1/2"×3/8"×14"	2
10	FLAT IRON	2"×3/8"×19"	2
11	FLAT IRON	3/8"×1 1/2"×19 1/2"	1
12	BOILER PLATE	20"×25 1/2"×1/2"	1
13	BOILER PLATE	12"×19"×1/4"	1
14	C.R.S.	12"×1" DIA.	1
15	C.I.		1
16	C.I.		1
17	C.I.		1
18	W.I. PIPE	1 1/2"	
19	W.I. PIPE	1/4"	
20	W.I. PIPE	1"	
21	TANK RIVETS	5/16"×1"	72
22	EYE BOLT	3/8" DIA.	1
23	HEX. HD. BOLT	1/2"×2"	1
24	HEX. HD. BOLT	1/4"×1"	8
25	HEX. HD. BOLT	5/16"×1 1/2"	2
26	FIRE BRICK		35
27	FIRE BRICK	NO. 1 ARCH.	26
28	NOZZLE STICKTITE TO FIT 1" PIPE		1
29	GAS BLOWER UNIT		1

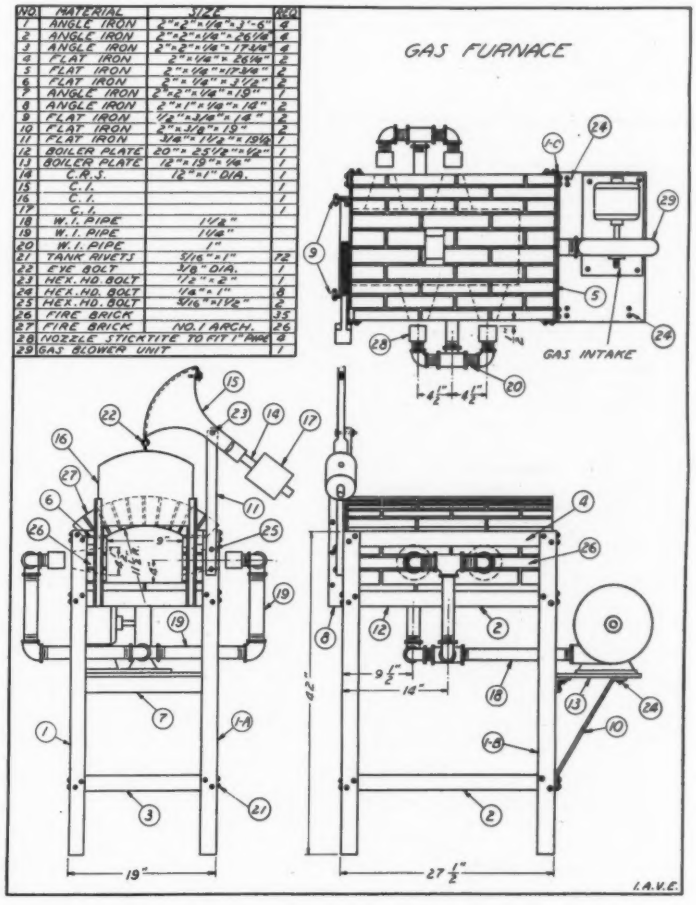


Fig. 1. Gas furnace assembly. *Article on page 332*

Mounting the Motor

Put the boat in the water and put the motor in the boat. Keep in mind which way the shaft rotates so the boat will run forward when finished, instead of backward. Move the motor from side to side, until the boat sets level in the water. The shaft should be about 4½ in. from the stern. When a good balance is obtained put marks on the inside of the boat where the shaft rests, and on the bottom where the motor rests. Also mark the shaft where the edges of the boat are. Cut off the shaft ¼ in. outside these marks. Punch holes in the two paddle wheels and solder them squarely and securely to the ends of the shaft. Tin the two places on the frame that rests on the bottom of the boat. Place the power plant in the boat and solder it to the bottom. Make two U-shaped clips to hold the shaft in place (see B, Fig. 3). Use pieces of No. 18 wire 1¼ in. long for the clips, and see that they fit the shaft very loosely.

There is a small-sized alarm clock that provides a much lighter movement for the power plant. If one of these can be had they will make a very satisfactory motor for the boat.

GAS FURNACE

S. L. Coover, State Teachers College, California, Pennsylvania

The gas furnace shown in Figure 1 is a very useful piece of equipment in the school shop. It may be used for melting soft metals, annealing, tempering of tools and heating steel blanks that are to be formed into disk wheels and other useful shapes.

The frame of the furnace is steel. The end and side pieces (see Fig. 2) are securely riveted to the legs. A bracket is riveted on to the rear legs to support the gas blower unit. The door guides are riveted on the upper front pieces and the lever support is bolted on the front right leg. The clay-lined door is raised or lowered by a lever fastened to the lever support by a bolt. A cast-iron counterweight balances the weight of the door.

The gas furnace

High-grade fire brick and a high-temperature cement are used in lining the furnace. The bed plate is covered with one course of brick to form the bottom. The side and back walls are three courses high. In the middle course two tuyères are

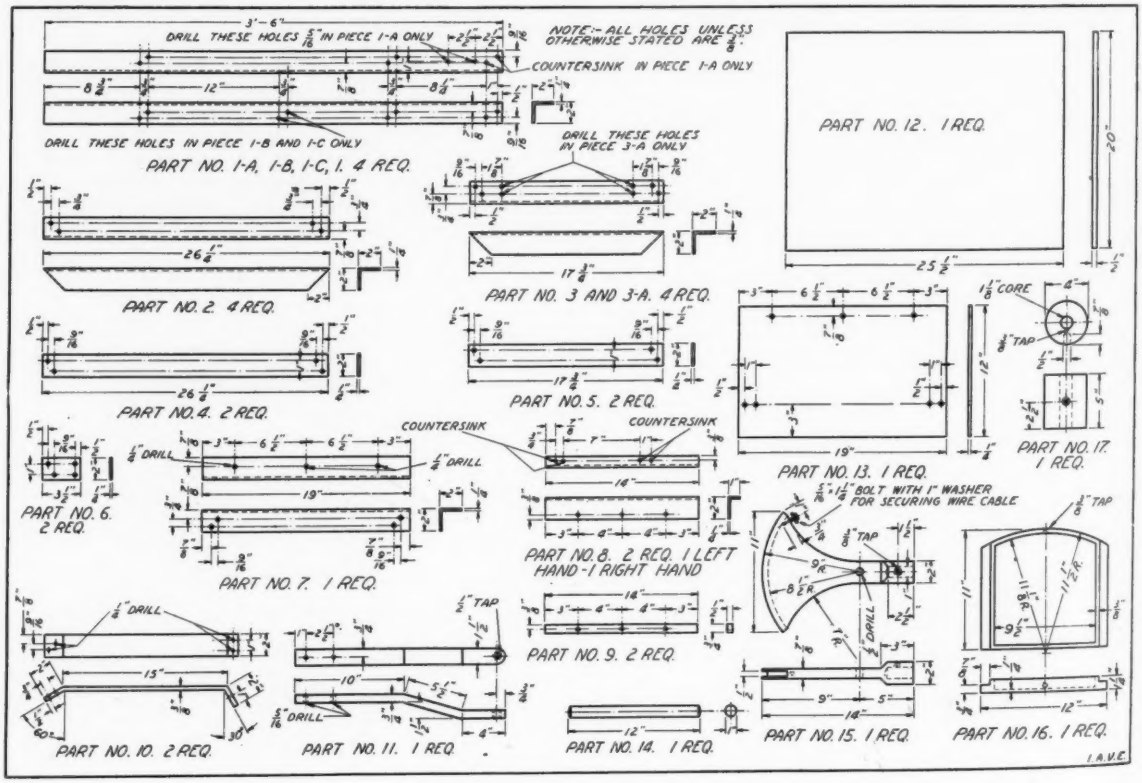

NOTE:- ALL HOLES UNLESS OTHERWISE STATED ARE ⅜".
DRILL THESE HOLES 5/16" IN PIECE 1-A ONLY
COUNTERSINK IN PIECE 1-A ONLY
DRILL THESE HOLES IN PIECE 1-B AND 1-C ONLY
PART NO. 1-A, 1-B, 1-C, 1. 4 REQ.
DRILL THESE HOLES IN PIECE 3-A ONLY
PART NO. 12. 1 REQ.
PART NO. 2. 4 REQ.
PART NO. 3 AND 3-A. 4 REQ.
PART NO. 4. 2 REQ.
PART NO. 5. 2 REQ.
PART NO. 6. 2 REQ.
PART NO. 7. 1 REQ.
PART NO. 8. 2 REQ. 1 LEFT HAND - 1 RIGHT HAND
PART NO. 9. 2 REQ.
PART NO. 10. 2 REQ.
PART NO. 11. 1 REQ.
PART NO. 13. 1 REQ.
PART NO. 14. 1 REQ.
PART NO. 15. 1 REQ.
PART NO. 16. 1 REQ.
PART NO. 17. 1 REQ.
⅝" BOLT WITH 1" WASHER FOR SECURING WIRE CABLE
I.A.V.E.

Fig. 2. Gas furnace details

made in each side for the burners. The tuyères are 4½ in. in diameter on the inside, and 2½ in. in diameter on the outside. The crown is made of No. 1 arch brick. The radius of the crown is 12 in. A vent hole is left in the crown to allow burnt gases to escape when the door is closed. This hole may be closed by a brick cut to fit the tapered opening.

The gas blower unit is bolted to the bench. It has a connection for ¾-in. gas pipe. The blower is tapped to receive 1½-in. pipe. This pipe leads under the furnace where it branches off and reduces to 1¼-in. pipe which leads to the burners. At the burners the pipe reduces to 1-in. pipe, to fit the "Sticktite" nozzles.

VISUALIZING SOLIDS

C. M. Rice, North Junior High School, Everett, Washington

In order to assist the beginner in mechanical and free-hand drawing in the junior high school in the visualization of those objects which he is to draw, the writer prepared a number of 2 by 6-in. softwood blocks. The four sides were carefully surfaced and the ends were sanded smooth. Then they were given a coat of black paint, although a deep shade of any other color would have served just as well.

Leaving one block undisturbed (see A, Fig. 1) to serve as an original model, parts may be cut from the remaining blocks (see B, C, and D, Fig. 11) in various places, without destroying the over-all dimensions of the original block. Those surfaces that stand revealed after the removal of parts of the block are then to be painted white or some other light color. In this way, a useful series of blocks for demonstration purposes may be made to assist the student to progress from the simple to the more complex shapes.

Another method consists of painting all edge surfaces one shade of color, and the end surfaces another color. In this way, the different views of each block can be more readily seen. This method is shown at A, B, C, D, E, F, G, and H, Figure 5.

In order to carry out the idea of keeping the original form of the block intact, the scheme was devised to cover all of the blocks with transparent material such as sheet celluloid. This is shown in Figures 1, 2, 3, and 4. The celluloid used for automobile curtains serves very well. To prepare this celluloid for covering the blocks, it was tacked to the drawing board. Then with a T square and a triangle, the surface development of the block was made upon it. The lines were then scratched

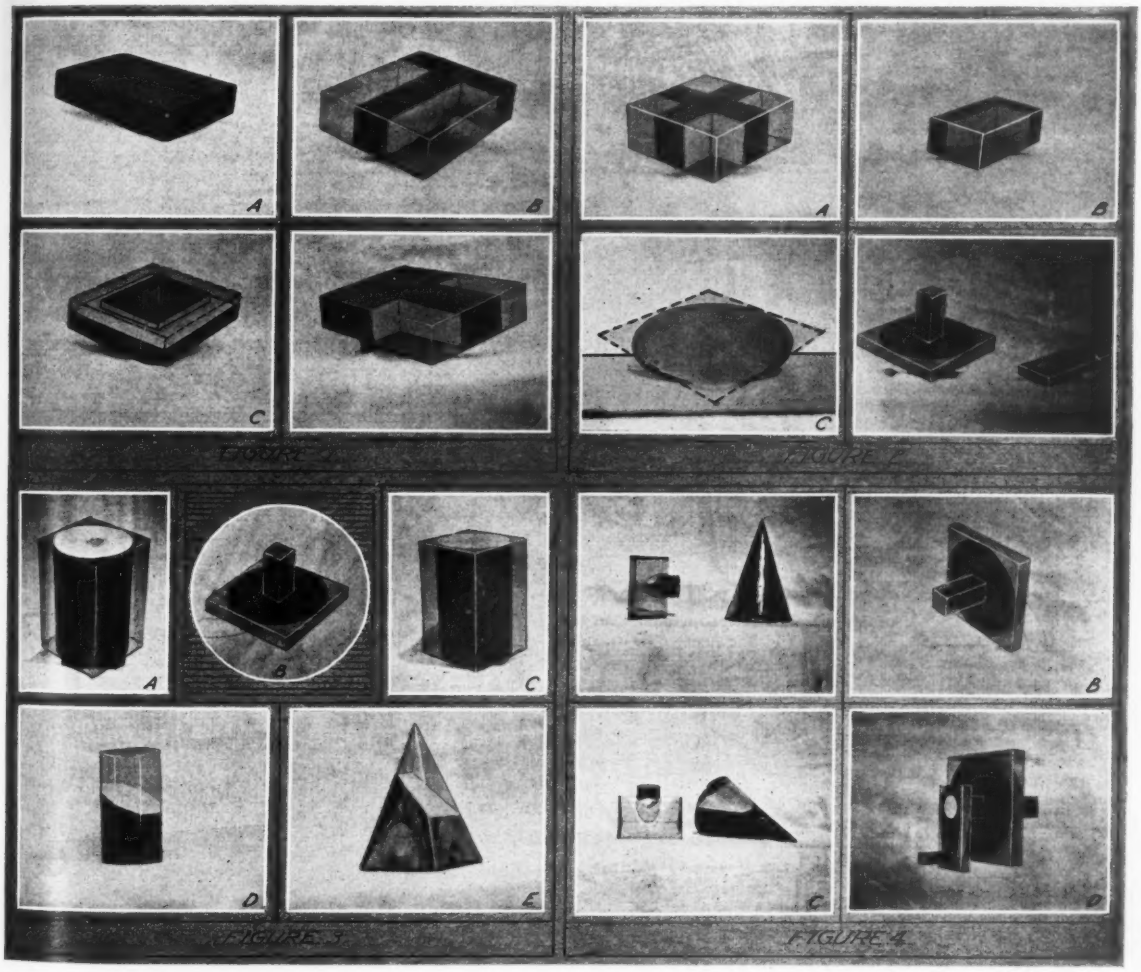


Fig. 1. The first block as well as three celluloid-covered blocks, all having the same outside dimensions. Fig. 2. A cross-shaped block, an L-shaped block, a circle painted within the boundaries of a square sheet of celluloid, and also a wheel and axle with the crank removed. Fig. 3. At A, B, and C are shown the celluloid-covered models in position for the study of ellipses and sketching of solids. At D and E are shown a truncated octagonal block and a truncated pyramid respectively. These latter two are used for explaining auxiliary views. Fig. 4. At A and C are models of cones and of intersections of cylinders with triangular prisms. B and D show a model of a wheel and of a wheel, axle, and crank, respectively

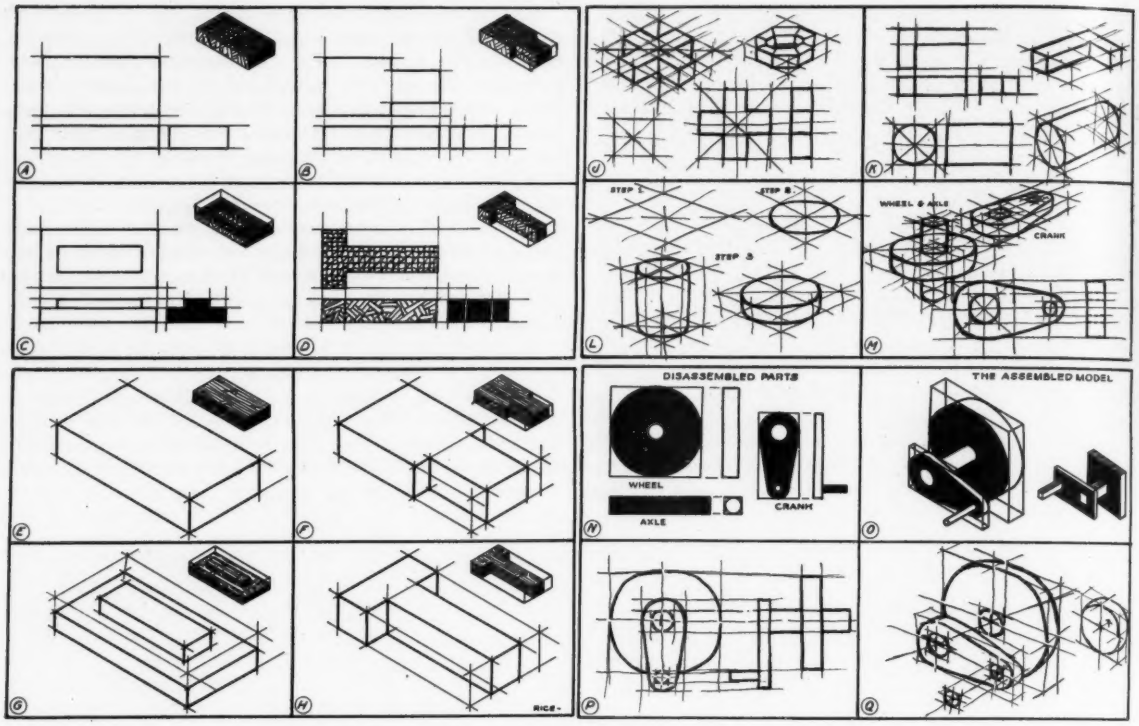


Fig. 5. At A, B, C and D are shown the celluloid-covered blocks with face, edges, and ends painted in distinctive colorings. These are used in teaching mechanical drawing. At E, F, G, and H are shown celluloid-covered models as used in teaching isometric drawing. At J, K, L, M, and N, are shown rough sketches illustrating the use of the celluloid-covered models in teaching quick pencil sketching. At N and O are shown celluloid-covered models of the parts and of the assembly of wheel, axle, and crank. At P and Q are the sketches produced from these models

in with a sharp scriber. The pattern was then cut out. The bending of the celluloid to the shape of the blocks is not difficult, as it will readily bend along the scribed lines, and the pressure and warmth of the hands will assist in bending it to the proper angle. For more difficult work, the celluloid may have to be heated on a heavy iron plate placed on top of an electric stove, the heat of which can be regulated by means of a rheostat. When using this method, care must be taken not to heat the celluloid too much and thus warp it. After the celluloid has been formed over the block, it is held in place with weights or pins until the open seams are cemented. The cement used for this purpose may be made by dissolving thin strips of celluloid in amyl acetate (banana oil). This may be done in a wide-mouthed bottle. It is necessary to shake the bottle frequently so that the dissolving celluloid does not settle to the bottom in a thick, sticky mass. After about 24 hours, this cement has the consistency of mucilage and is then ready to apply to the seams and joints. The cement does not stick in the manner of paste or mucilage, but actually dissolves the celluloid surfaces. After allowing the seams to dry several hours, they will be found to be as solid and as homogeneous as the rest of the celluloid.

Other models such as cylinders, wheels, and sections of hexagonal and octagonal blocks also were made and boxed in with the celluloid (see Fig. 3). Intersections of cylinders with triangular prisms with hexagons were laid out on the sheet celluloid and cemented together, as shown in Figure 4, thus making very interesting and instructive models for demonstration purposes.

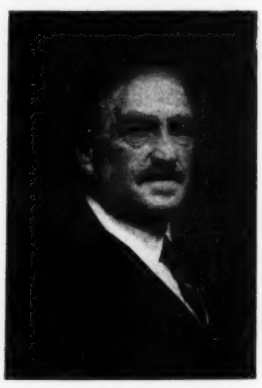
This method of boxing-in the forms with transparent material was found to serve exceedingly well in the visualization of objects both for mechanical drawing and freehand sketching. Some of the methods used in the freehand sketching from these models are indicated in Figure 5.

Personal News

OLD LEADER PASSES

Walter Scott Perry, Director of the School of Fine Arts, Pratt Institute, for forty years, died at his summer home in Stoneham, Mass., on August 23, at the age of 79 years.

Walter Scott Perry studied at the Massachusetts Normal Art School in Boston. From 1875 to 1879 he was director of drawing in the public schools of Fall River, Mass. Later he went to Worcester, where he became director of art education in the pub-



WALTER SCOTT PERRY

lic schools. In 1887 he was appointed head of the department of fine and applied arts at Pratt Institute, where he remained until his retirement six years ago. He was well known as a lecturer on sculpture, architecture, and painting and was the author of a number of books and magazine articles on art.